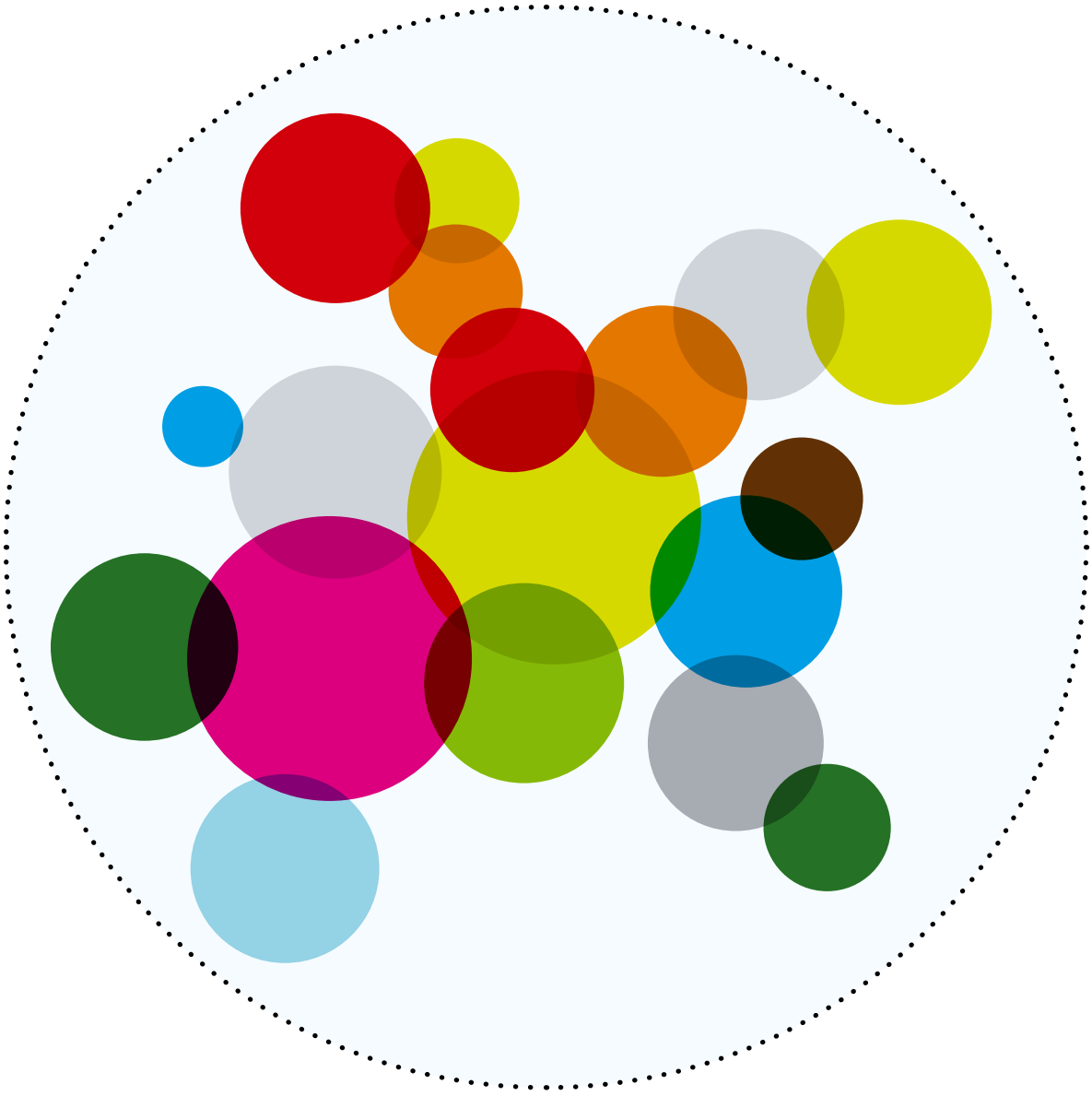
REDEFINING THE FOOD SECTOR



PART I:

The modern food industry in the Øresund Region, a statistical approach

PART II:

Food research, education and collaboration in the Øresund Region

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REDEFINING THE FOOD SECTOR

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PART II

FOREWORD

The cross-border region of Denmark and Sweden, the Øresund Region, is a unique two-country region with a large quantity of academic and industrial competencies within several areas. Food is one of them.

A comprehensive food cluster exists in the Øresund Region. The food cluster is composed of food research, industry and public authorities, as well as food-related activities. The food cluster also includes innovation-supportive organisations, science parks, incubators and food networks. All in all, an extremely broad array of competencies makes the Øresund Region a world leader as a food region and attractive for foreign investments.

Still, the full picture is missing. The size of the entire food sector is not known, and obvious food-related industrial areas are, at present, not included in the definition of the food sector. The magnitude of the food-related research being performed, education being offered and innovation-supportive organisations being built and utilised in the Øresund Region has yet not been fully described. The present study, initiated by Øresund Food, will make up for this lack of information.

With this report, Øresund Food hopes to highlight the quantity and quality of the large food sector in the Øresund Region, which will underscore the fact that the Øresund Region is a world-class leading food region.

Maria Olofsdotter, CEO
Øresund Food
May 1, 2011

REDEFINING THE FOOD SECTOR IN THE ØRESUND REGION

A COMPREHENSIVE STUDY OF THE MAGNITUDE OF THE FOOD SECTOR AND FOOD-RELATED RESEARCH, EDUCATION AND COLLABORATION IN THE ØRESUND REGION OF DENMARK AND SWEDEN

INTRODUCTION

The Øresund Region is a unique two-country region that is known for its position as a leading food region with respect to the food industry, food research and food education. However, the traditional, statistical definition of the food sector is far from accurate, and an overview of food-related research, education and innovation-supportive organisations is lacking. This report seeks to redefine the food sector as it corresponds to a modern food supply chain and to create an overview of the large and comprehensive food sector in the Øresund Region.

We recommend reading this report in conjunction with the 2010 analyses performed by FORA ("International comparison of agricultural and food clusters") and the Danish Agency for Science, Technology and Innovation ("Mapping of Danish food research").

BACKGROUND FOR THE STUDY

The food sector in the Øresund Region is comprehensive, but the full range of its activities and number of employees has not, up until now, been described. Several food-related sectors and industries have not been included in the statistical material that traditionally describes the sector. This is misleading and makes the branding process for the region difficult due to lack of information.

In 2009, Øresund Food participated in dialogue with, among others, the organisations Copenhagen Capacity and Invest in Skåne, internal investment agencies in the Øresund Region. The dialogue was centred on how to successfully brand the Øresund Region as a leading food region. Through two inspiring workshops and in collaboration with the steering committee for Øresund Food's EU-funded project Healthy Growth, it was agreed upon that a redefinition of the food sector was needed and that the region's food-related research, education and collaborations should be mapped in accordance with the new definition.

"Redefining the food sector in the Øresund Region" was initiated and carried out within the scope of Øresund Food's EU-funded project Healthy Growth, a project that aims to bring the Øresund Region among the top regions within food, health and nutrition by 2015. The report was finalised and marketed in cooperation with the EU-funded project FoodBEST Øresund, which works for the region's establishment of and participation in a Food Knowledge and Innovation Community, or FoodKIC.

CONTENT OF THE REPORT

The report consists of two parts, approaching the modern food sector in the Øresund Region from two different angels: a statistical approach to the modern food industry and a knowledge-intensive approach to food-related research, education and collaboration. Each part is introduced and summarised separately. The two parts are:

Part I. Redefining the food sector: The modern food industry in the Øresund Region, a statistical approach

Part II. Redefining the food sector: Food research, education and collaboration in the Øresund Region

PART I

REDEFINING THE FOOD SECTOR: THE MODERN FOOD INDUSTRY IN THE ØRESUND REGION, A STATISTICAL APPROACH

1. INTRODUCTION

1.1 AIM AND FOCUS OF THE REPORT

Today, when using official statistics, there is no standard definition for the modern food industry that meets our needs. We miss the cluster perspective! With this report, we explore if and how it is possible to include all elements in the value chain related to food production, from stable to table and all the way back to the soil again.

We will suggest new guidelines for what to include when talking about the modern food industry and investigate if it is possible to describe the modern food industry by re-grouping official statistics. The new definition presents not only traditional areas of the food industry but also includes industries and disciplines that have a strong link to, or act in symbiosis with, the food industry. The new definition of the food industry will make it easier to discern whether or not there is, in fact, a food industry cluster in the countries we are examining and, if so, what the cluster looks like and where it is located. In other words, it can be used for international benchmarking.

We will use this new definition of the modern food industry to take a closer look at the food industry in Denmark and Sweden, specifically the region that connects these two countries, the *Øresund Region*. This geographically defined area has been selected because several stakeholders, studies and reports[1] indicate that there is a large and important food cluster in Denmark and in the southern part of Sweden. We distinguish between a *food cluster* and a *food industry cluster.* This report, Part I, focuses on the food industry cluster; for the reader to get a full picture of the Øresund Region food cluster, we recommend also reading "Part II. Redefining the food sector: Food research, education and collaboration in the Øresund Region".

This is not an attempt to do a scientific analysis of the food industry cluster. This report should be viewed as first step in defining the modern food industry and in seeing if it is possible to describe the modern food industry in a comprehensive way – using official statistics and the cluster perspective.

1.2 DISPOSITION

We begin by defining the key terms and describing the classification system for statistical data used in the report, as well as by highlighting the geographical focus of the report (Chapter 2). Then, we guide the reader through our working model to re-define the food industry (Chapter 3), and in conjunction with that, analyse and discuss the statistical codes to be included in our redefinition of the food industry (Chapter 4). In Chapter 5, our final, modified model for re-defining the food industry will be presented, alongside a summary of dilemmas and limitations faced in extracting relevant statistical data. Finally, in Chapter 6,

1 Among others: European Cluster Observatory, www.clusterobservatory.eu; Region Scania, www.skane.se; Food Innovation Network Europe, www.networkfine.net; and, FORA, "Den danske landbrugs- og fødevareklynge i et internationalt perspektiv" February 2010.

we apply our modified model for re-defining the food industry to the Øresund Region. Actual numbers and characteristics from the Øresund Region will be presented and discussed from a cluster perspective. A conclusion (Chapter 7) and some perspectives on where to go from here close the report (Chapter 8).

For your information, the annex to the report includes all referred-to NACE codes (European standard codes for classifying economic activity).

2. DEFINITIONS, STATISTICAL DATA AND GEOGRAPHY

2.1 STANDARD DEFINITIONS OF THE FOOD INDUSTRY

The food industry is the largest manufacturing industry in Europe and accounts for 13.4% of the total industrial output among countries in the European Union[2]. Even as it is one of the largest and most important industries, the definition of what to include when talking about the food industry is not always clear and there are no real guidelines. For instance, it is common to include production of non-food, such as production of tobacco products and growing of plants for ornamental purposes when describing the food industry. And it is common to exclude ingredients. Indeed, we have encountered many different ways of defining the food industry.

The food industry is typically defined as *manufacture of food and beverages* when it is put into figures, and this is the standard definition of the food industry when it comes to statistical reporting of economic activity. This is the definition used by The European Cluster Observatory when identifying and evaluating industry clusters in Europe. But this definition leaves out several key elements in the value chain related to the production of food. Therefore, it does not give a clear, accurate picture of a cluster, which according to cluster theory should also include the different levels of supply to the food industry (see Chapter 2.2).

Another organisation under the European Commission is Eurostat, which in our opinion has contributed with the best definition of the modern food sector so far. In a report from 2008 called "Food: From farm to fork statistics", Eurostat includes what they see as the whole value chain related to food production:

- Farm production stage
- Processing stage
- Distribution stage
- Consumption stage

Thus, the whole value chain – from raw material to consumption – is included in the Eurostat report. However, when digging into the numbers, we see that the report does not, for example, include machinery and equipment, transport and cargo, packaging industry or food service as a part of the food industry. The cluster perspective is missing because the different levels of supply are lacking.

2 *Confederations of the Food and Drink Industries of the EU, www.ciaa.be*

2.2 DEFINITIONS OF FOOD INDUSTRY, FOOD CLUSTER AND FOOD INDUSTRY CLUSTER

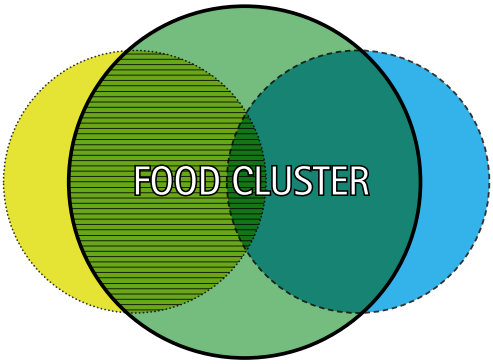
Since we are, in this report, taking a cluster perspective on the food industry in the Øresund Region, it is important to define what is meant by the term *cluster* and to explain how we differentiate between the terms *cluster, food industry* and *food industry cluster.*

The term *cluster* is constantly being challenged and has many vague definitions. Originally, the term referred to the theory that industrial geographical concentrations give companies in that specific area a synergy effect *because* of the geographical proximity. Today, a cluster is typically regarded as a geographically defined area, in which an industry is particularly concentrated. This industry should be located close to and be in close interaction with science and education in the scientific fields corresponding to the industry. Many also regard interaction with public authorities as a must for defining a region as a cluster. Silicon Valley is often mentioned as an example of an ICT cluster because of the many companies that either produce or support the production of ICT equipment and create synergy effects in the area based on their geographical proximity and close relation to universities and research institutions.

In this report on redefining the food sector, when we refer to a *food cluster*, we mean precisely this: a geographically-defined area in which there is a high concentration of food production and food-related business and science related to food business. A food cluster includes not only core businesses – the food manufacturers – but also related businesses such as suppliers.

Part I of this report focuses on the industrial part of the food cluster, which we call the *food industry cluster*, while Part II focuses on mapping the food knowledge – the research, education and collaboration that are related to food. When we mention the *food industry*, we are referring to food business in or connected to food production, whether located within the *food cluster* or not.

Figure 1 is our attempt to illustrate how the food cluster and the food industry are determined. The overlapping area between these two illustrates what we refer to as the food industry cluster.



Food Cluster: Within a geographically defined area, and including relevant food industry and food knowledge (universities, knowledge institutions, innovation stakeholders)

Food Industry: A part of the food industry does not belong to the Food Cluster due to being placed outside the geographical boundaries of the Food Cluster

Food Industry Cluster: A part of the total food industry belongs to the Food Cluster due to a geographical position within the Food Cluster – called the Food Industry Cluster

Food Knowledge: Includes universities, knowledge institutions and innovation stakeholders working with food related knowledge (a part falls outside the total Food Cluster due to being placed outside the Food Cluster's geographical boundaries & due to non-food related activities)

Figure 1. Overlaps between food cluster, food industry and food knowledge

For more on cluster theory, see Michael E. Porter's article "Clusters and the New Economics of Competition" in *Harvard Business Review*, November/December 1998.

2.3 STATISTICAL CLASSIFICATION STANDARDS

In this report, we use national statistics based on NACE codes[3]. NACE is a standard code used when reporting economic activity to statistic agencies in all countries in Europe. The NACE codes are based on international standards (ISIC standards), and are also used as standard guidelines for statistical classification at a national level. The connection between international statistical classification standards and national standards are shown in figure 2.

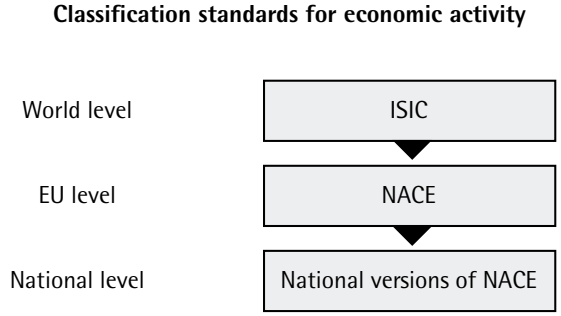


Figure 2. Connection between national and international standards of statistical classification for economic activity

3 *NACE Rev2, Statistical classification of economic activities in the European community (2008)*

Each NACE code is made up of a four-digit, top-down system of three parts. The first two digits determine a *division*, the third digit determines the *group*, and the last digit determines the most detailed level, *class*. In the example in table 1, the *class* 10.12, *Processing and preserving of poultry meat*, belongs to *group* 10.1 - *Processing and preserving of meat and production of meat products*, which is a group within *division* 10: *Manufacture of food products.*

TABLE 1. EXAMPLE OF THE NACE CODE CLASSIFICATION PRINCIPLE

Level	NACE-code	Title
Division	*10*	*Manufacture of food products*
Group	10.1	Processing and preserving of meat and production of meat products
Class	10.11	Processing and preserving of meat
Class	10.12	Processing and preserving of poultry meat

In recent years, Eurostat has reviewed and updated the definitions upon which NACE codes are based. This was done to make comparisons between industries and countries easier. NACE codes are still classified by the nature of the activity of the reporting company, such as mining of coal, manufacture of textiles or construction of water projects. The NACE codes include, besides the nature of the activity, products, services, processes and technologies (i.e., the same factors we are looking at in this report).

There is, however, no information about linkages between different groups in the NACE coding system. Thus, if you choose only to look at the NACE divisions, the numbers can be very misleading, as they include companies with very diverse activities. For instance, whether a company is transporting frozen vegetables over half a continent or taking people from the suburbs to the city, it belongs to the same NACE division. And, as will be explained in greater detail, even at a group level, activities can be so diverse that it becomes irrelevant to include the whole group. In this report, our goal is to extract the figures that reflect the reality of the food sector more accurately by selecting appropriate data at a NACE class level.

When working with NACE codes, one should keep in mind that companies themselves define which NACE class they belong to. A company can only classify itself within one class even it is operating in several industries. This may cause difficulties when interpreting extracted numbers.

Additionally, although NACE codes are standard classifications, they are being interpreted at a national level, which affects the extracted data from national statistics. When making comparative analyses based on national statistics, one should keep this in mind.

2.4 PRIMARY AND SECONDARY DATA

In this report, primary data refers to national statistical data, while secondary data refers to literature and statistical analysis provided from various, other sources.

PRIMARY DATA

Most of the statistical data used in this report has been retrieved from official statistic agencies in Denmark (Danmarks Statistik) and Sweden (Statistiska centralbyrån). As described above, national data is classified based on international standards. In Denmark and Sweden, there is a clear and close connection between the national classifications and NACE codes. Still, in handling data at a national level, the NACE codes are subject to interpretation, both so that extracted data abides by national law and/or so that it can be used for nation-specific purposes. For instance, a definition of a *company that should be included in the statistics* has not been determined internationally; since Denmark and Sweden have different definitions for this classification, extracted data on classes that are apparently the same, will not reflect precisely the same reality.

Also, in Denmark and Sweden, confidentiality rules apply, so it is not possible to spot individual companies in the statistics. This means that information from classes, in which there are only a few companies, will not be presented. The same goes for groups that include dominant players. This will, of course, affect the data we are working with. Where confidentiality rules have a major impact on a specific group, we will mention and discuss the implications. In general terms, the smaller the geographic area or the more detailed the level of NACE category, the greater the impact will be on the outcome. This makes it more difficult to draw conclusions on data at a regional (sub-national) level.

We must bear the above-mentioned difficulties in mind while working with official statistics; however, we still find it meaningful to use official statistics since numbers from the national statistics can indicate tendencies quite accurately – and it is the only verifiable and publicly available data we have access to.

Initially, our intention was to extract and present data from national statistics that concern number of employees, number of enterprises and turnover. However, data on turnover is highly affected by confidentiality rules, which unfortunately makes it impossible to generate a meaningful overview of the economic activity at a regional (sub-national) level. That is why we concentrate on data that is less affected by confidentiality rules. In this case, we will use "*number of employees*" when we describe the size of the individual groups.

SECONDARY DATA

Some secondary data has also been used in this report. The secondary data has been supplied to us by associations linked to the different industries investigated. For example, the information about freight transport related to the food industry in Denmark was obtained from the Ministry of Transport, while in Sweden it came from SIKA (Swedish Institute for Transport and Communications Analysis). Other secondary data has been collected from ingredient companies and from international organisations such as WPO (World Packaging Organisation).

2.5 GEOGRAPHICAL FOCUS

In our mapping of the food industry, we look at food production in Denmark and Sweden as a whole, and the Øresund Region as the link that connects these two countries.

We will also take a closer look at the Øresund Region, to test if there is any food industry cluster in the region that connects the two countries. The geographical definition of the Øresund region includes Region Zealand County and the Capital Region on the Danish side and Region Scania on the Swedish side. The Danish side of Øresund will be referred to as Zealand and the Swedish side will be referred to as Scania. Some relevant background information on the regions is listed in table 2.

TABLE 2. BACKGROUND INFORMATION ON DENMARK, ZEALAND, SWEDEN, AND SCANIA

	Denmark	Zealand	Sweden	Scania
Population	5.511.000	2.484.000	9.257.000	1.214.000
Area	43.094 km^2	9.834 km^2	449.964 km^2	10.939 km^2
Population density	128/km^2	253/km^2	21/km^2	111/km^2
Total workforce	2.852.000	1.281.800	4.458.000	573.175

As can be seen from this table, the areas Zealand and Scania are quite different in size and population density. Where Zealand hosts almost 2.5 million people, around 1.2 million people live in Scania. The population density is also more than double for Zealand, as compared with Scania. The fact that Zealand includes the Capital Region of Denmark explains these differences.

3. OUR MODEL FOR REDEFINITION OF THE FOOD INDUSTRY

To help us redefine the food industry, we invited a group of experts[4] on this subject to a workshop. The purpose of the workshop was to develop a model for redefining the food industry and to identify all subjects to be included when talking about *the modern food industry* and a *food industry cluster.*

The expert group stated that, when studying the food industry, not only *manufacture of food and beverages* but also a number of complementing industries supporting and supplying food production should be included. The expert group agreed that a more comprehensive approach should be taken, and ideally, all parts of the value chain linked to the production of food should be included. This includes all important suppliers, customers (but not final customers/consumers) and support organisations.

The starting point of the expert group was the traditional definition of the food industry, being the *manufacture of food and beverages*, and other groups of industries were then added to embrace all of the modern food industry. The expert group divided the whole food industry into four *divisions* that each included several *groups* of industries. The four divisions of this expert definition were: *Food industry core, First level support, Second level support* and *Independent operators.* Whether a group belonged to one division or another depended on its relation to the *Food industry core.*

The outcome of the workshop is presented in figure 3. It represents the ideal way of dividing the food industry according to the expert group, and is the basis for our investigation. Each division is illustrated by a colour, and each individual circle indicates a group.

According to the expert group, all divisions and groups in the model presented in figure 3 should be included when talking about the *food industry.* However, when it comes to describing a *food industry cluster*, the expert group includes the groups within the light blue circle only. The food industry cluster includes the divisions:

- Food industry core: *Manufacture of food and beverage, Ingredients industry* and *Food service* (dark blue colour)
- First level supply: *Agriculture food cluster*[5] and *Machinery and equipment for the food industry* (green colour)
- Second level support: *Packaging industry, Transport and cargo, Wholesale food* and *Materials recovery* (yellow colour)

The fourth division (red colour) covers Independent operators and is, according to the expert group, not to be included when describing a food industry cluster. This will be discussed in Chapter 4.4.

4 Lena Åsheim (CEO–Krinova), Henning Otte Hansen (Senior Advisor, The Institute of Food and Resource Economics), and Björn Lagnevik (Business Advisor Region Scania)

5 We use the term "agriculture food cluster" as this covers not only the agricultural production for the food industry, but also its suppliers – and it excludes all non-food agriculture (see Chapter 4.2).

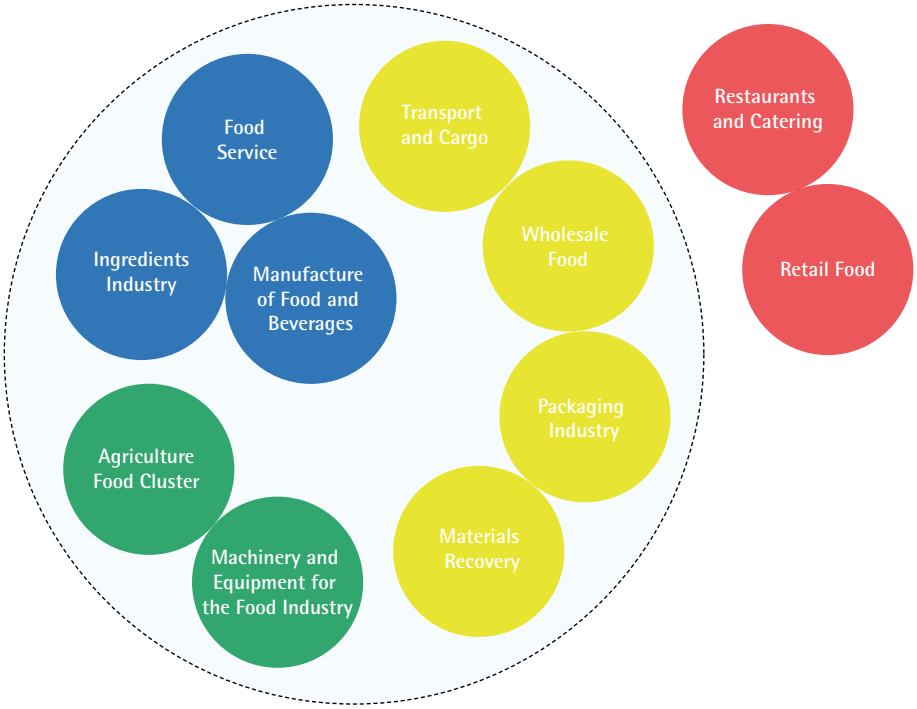


Figure 3. Division of the food industry according to the expert group. Blue labels represent industry groups belonging in the food industry core; green labels represent industry groups belonging in the first level supply; yellow labels represent industry groups belonging to second level supply; and red labels are the independent operators. The light blue circle defines the boundaries of the food industry cluster.

The arguments for the above-mentioned divisions and the boundaries of each group will be presented and discussed in detail in the following chapter. We will investigate the expert group's industry groups in order to define their relation to the food industry core. In addition, we will discuss obstacles and, based on this, list the relevant divisions, groups and classes extracted from official statistics which correspond with our recommendations.
To make it possible to compare the numbers in our study with numbers from other food industry clusters in the world, we use only official data classified within the NACE system. However, in some cases (e.g. for ingredients and agriculture food cluster), instead of using the already existing NACE division, we will try to construct our own divisions and groups according to the model we have developed.

4. ANALYSIS – INDUSTRY BY INDUSTRY

In this chapter, each of the above-described divisions and groups defined by the expert group will be analysed and discussed in terms of their relation to the food industry core. More specifically, their financial dependency on and knowledge exchange with the food industry core, as well as their relation with the food industry core in terms of size, will be analysed and discussed. We will recommend whether or not specific NACE classes should be counted as part of the statistics regarding a food industry cluster. Our final recommendations will be summed up in Chapter 5. (A list of all included and analysed NACE codes can be seen in Annex I.)

4.1 FOOD INDUSTRY CORE

The groups *Manufacture of food and beverages, Food service* and *Ingredients industry* belong to the division *Food industry core* according to the expert group. The division is characterized as being 100% engaged in the processing and production of food on a large scale or manufacturing products that are included in the production of food.

4.1.1 MANUFACTURE OF FOOD AND BEVERAGES

This group is used when presenting the food industry in a more traditional way. It includes the processing of products from agriculture, forestry and fishing into food for humans or animals and the production of various intermediate products, which are not directly food products such as manufacture of starches. The group also includes manufacture of beverages, such as non-alcoholic beverages, mineral water, alcoholic beverages manufactured mainly through fermentation (e.g., beer and wine), and distilled alcoholic beverages[6]. In table 3, selected NACE classes belonging to the group *Manufacture of food and beverages* are listed according to our definition. The list is on a class level because, as mentioned in Chapter 2.3, groups and divisions in official statistics typically include classes not relevant for the food industry, and it will prove important later to excluding irrelevant classes. In the case of *Manufacture of food and beverages*, all the existing classes are included.

6 *NACE Rev. 2 Statistical classification of economic activities in the European Community (2008)*

TABLE 3. NACE CLASSES THAT WE RECOMMEND BE INCLUDED IN THE GROUP MANUFACTURE OF FOOD AND BEVERAGES

From NACE division 10 Manufacture of food products
• *From group 10.1 Processing and preserving of meat and production of meat products* ¤ 10.11 Processing and preserving of meat ¤ 10.12 Processing and preserving of poultry meat ¤ 10.13 Production of meat and poultry meat products • *From group 10.2 Processing and preserving of fish, crustaceans and molluscs* ¤ 10.20 Processing and preserving of fish, crustaceans and molluscs • *From group 10.3 Processing and preserving of fruit and vegetables* ¤ 10.31 Processing and preserving of potatoes ¤ 10.32 Manufacture of fruit and vegetable juice ¤ 10.39 Other processing and preserving of fruit and vegetables • *From group 10.4 Manufacture of vegetable and animal oils and fats* ¤ 10.41 Manufacture of oils and fats ¤ 10.42 Manufacture of margarine and similar edible fats • *From group 10.5 Manufacture of dairy products* ¤ 10.51 Operation of dairies and cheese making ¤ 10.52 Manufacture of ice cream • *From group 10.6 Manufacture of grain mill products, starches and starch products* ¤ 10.61 Manufacture of grain mill products ¤ 10.62 Manufacture of starches and starch products • *From group 10.7 Manufacture of bakery and farinaceous products* ¤ 10.71 Manufacture of bread; manufacture of fresh pastry goods and cakes ¤ 10.72 Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes ¤ 10.73 Manufacture of macaroni, noodles, couscous and similar farinaceous products • *From group 10.8 Manufacture of other food products* ¤ 10.81 Manufacture of sugar ¤ 10.82 Manufacture of cocoa, chocolate and sugar confectionery ¤ 10.83 Processing of tea and coffee ¤ 10.84 Manufacture of condiments and seasonings ¤ 10.85 Manufacture of prepared meals and dishes ¤ 10.86 Manufacture of homogenised food preparations and dietetic food ¤ 10.89 Manufacture of other food products n.e.c. • *From group 10.9 Manufacture of prepared animal feeds* ¤ 10.91 Manufacture of prepared feeds for farm animals ¤ 10.92 Manufacture of prepared pet foods • *From group 11.0 Manufacture of beverages* ¤ 11.01 Distilling, rectifying and blending of spirits ¤ 11.02 Manufacture of wine from grape ¤ 11.03 Manufacture of cider and other fruit wines ¤ 11.04 Manufacture of other non-distilled fermented beverages ¤ 11.05 Manufacture of beer ¤ 11.06 Manufacture of malt ¤ 11.07 Manufacture of soft drinks; production of mineral waters and other bottled waters

4.1.2 FOOD SERVICE

This group includes industrial catering, that is, the provision of food services based on contractual arrangements with the customer for a specific period of time. The operation of food concessions at sports and similar facilities is also included. The food is usually prepared

at a central unit. This group includes operation of canteens or cafeterias (e.g., for factories, offices, hospitals and schools) on a concession basis.

In the NACE codes, this group is lumped together with restaurants and catering, which according to us and the expert group is incorrect. We define restaurants and catering as independent operators (see later). From our point of view, the group *Food service* is a natural part of the food industry cluster because food service companies operate similarly to food manufacturers. They depend on the cluster, and they have a high level of knowledge exchange with the cluster. If you look at the big food companies in Sweden, there are a number of companies that have subsidiaries focusing entirely on the food service segment. Some call the sector industrial catering; this term illustrates that it is a manufacturing industry and not restaurant business. In the following table, the NACE classes belonging to the group Food service are listed according to our definition.

TABLE 4. NACE CLASSES THAT WE RECOMMEND BE INCLUDED IN THE GROUP FOOD SERVICE

From the NACE division 56 Food and beverage service activities
• ***From group 56.2 Event catering and other food service activities***   ¤ 56.21 Event catering activities   ¤ 56.29 Other food service activities

4.1.3 INGREDIENTS INDUSTRY

Ingredients are products and chemical components used for the production of food. When taking a closer look at the statistics on the ingredients industry, two challenges arise. No NACE group or class includes the ingredients industry as a whole. Instead, the industry can be found in various NACE codes. Also, companies in the ingredients industry often find themselves caught between groupings in the official statistics as their products may be targeted towards various industries. Thus, they may end up being counted as a company belonging to a group not related to the food industry at all, even though they provide ingredients for the food industry.

In an attempt to overcome these challenges, we have tried to split up the group *Ingredients industry*, and construct two new groups: *Manufacture of food-related chemicals* and *Basic pharma*. As mentioned before, some ingredients producers can also be found in the group *Manufacture of food and beverages* (see 4.1.1); they are not included in these two new groups. The new groups are constructed so that the NACE classes within them all come from the same, already existing NACE division. This is done to clarify the origins of the new groups from the NACE system and to make it possible to separate the groups later on. For example, our group *Manufacture of food-related chemicals* contains only NACE classes from the NACE division 20: *Manufacture of chemicals and chemical products*. The same applies to our group *Basic pharma*, which only includes classes from the NACE division 21: *Manufacture of basic pharmaceutical products and pharmaceutical preparations.* This classification corresponds with recommendations from the expert group, but bear in mind that they are *constructed* groups. The two constructed groups will be described in detail below.

MANUFACTURE OF FOOD-RELATED CHEMICALS

This constructed group includes companies that manufacture products in a chemical processing system designed for the production of food. Examples of products included in this group are glycerol, acetic acid, fatty acids and mixtures of odoriferous products for the manufacture of food.

Companies included in the group *Manufacture of food-related chemicals* can be found in the various NACE codes, for instance, the group *Manufacture of other chemical products n.e.c.,* in which Danisco and Chr. Hansen, two relatively large food ingredient companies, belong. The food industry is not the dominant industry in this group and it is impossible to isolate food industry companies. The same problem occurs with the other chemical producers; in the NACE classes to which they belong, they may be impossible to isolate. However, including the whole class in food statistics would involve a lot of companies that do *not* belong, leading the statistics to be exaggerated. Because it is impossible to isolate companies related to the food industry within this NACE classes in question, we cannot include this group in our statistics, even though this will exclude relevant parties.

BASIC PHARMA

The argument for including some parts of *Basic pharma* in the definition of the food industry is that there is both financial interdependency and some level of knowledge exchange between this group and the other groups in the *food industry core.* Additionally, several companies in the constructed *Basic pharma* group have their origins in the food industry and still deliver input to food manufacturing companies, for instance, the Danish company Novo Nordisk[7]. There are also companies in Sweden that act in the overlapping area between the food industry and the pharma sector. *Basic pharma* can be found as an existing NACE class within division 21: *Manufacture of basic pharmaceutical products and pharmaceutical preparations*. The full class number and name is *21.10 Manufacture of basic pharmaceutical products.*

Although, theoretically, it is logical to include food-related companies from the *Basic pharma* industry, it becomes complicated when it comes to collecting data in praxis. This is because the few but large players in this industry may not be correctly represented due to confidentiality restrictions on the statistics. Another issue is that companies within *Basic pharma* have a diversified product portfolio and therefore, are sometimes reported in another NACE group or class within the same NACE division. Besides this, we do not have access to enough information on the percentage of food-related *Basic pharma* within this group. All of this means that we cannot include Basic pharma companies based on the existing statistics.

INGREDIENTS INDUSTRY: A POORLY COVERED GROUP

The conclusions above regarding the ingredients industry unfortunately mean that the food-related ingredients industry is very poorly covered when extracting statistical data from the official statistics.

In the future, when generating accurate statistics, important companies should be contacted directly for information on their food-related data (e.g., number of employees) or

7 Henning Otte Hansen, Tidsskrift for Landøkonomi – Fødevareklynger, (2009)

secondary data should be used to identify the percentage of food-related companies within each NACE class. Alternatively, new NACE classifications should be set up to give food ingredient companies the possibility to classify themselves as such.

If in the future, food-related ingredient companies can be isolated from their respective NACE classes, and thereby be included in statistics based on official data, they should definitely be included in the food statistics. In that case, we would find them to belong to the *first level support* division as they deliver input to the *food industry core*. In Annex II, we have gathered information on the companies that we regard as important first level suppliers for the food sector. We have mentioned only the largest; there are possibly many more.

4.2 FIRST LEVEL SUPPORT

According to the expert group, the *first level support* division consists of two different groups, the *agriculture food cluster*[8] and *Machinery and equipment for the food Industry.* What characterizes this division is that all output produced by the included companies is aimed at the division *Food industry core.*

4.2.1 AGRICULTURE FOOD CLUSTER

The agriculture food cluster encompasses two basic activities, production of crop products and production of animal products (covering also forms of organic agriculture, growing of genetically modified crops and raising of genetically modified animals). We have included growing of crops in open fields as well as in greenhouses. We have also included manufacture of pesticides and other agrochemical products, manufacture of agricultural and forestry machinery and veterinary activities.

We have excluded activities not aimed at the food industry, such as manufacture of tobacco products, growing of cotton and other textile fibres, growing of flowers, growing of rubber trees, growing of Christmas trees, and raising and breeding of pet animals. The forestry and logging activities, which are sometimes considered to be part of the agricultural sector, are also excluded in our definition.

By excluding all companies that are not linked to production of food, we probably exclude some large companies that produce both raw material for food and non-food industry but who do not define themselves as food companies in the NACE codes because the major part of their income is generated from non-food products. In the following table, the NACE classes belonging to the group *Agriculture food cluster* are listed according to our definition.

8 Here, the term "cluster" is used because it includes not only the core – the crop and animal production – but also the first and second level support for it, that is, machinery and equipment as well as chemicals for the industry.

TABLE 5. NACE CLASSES THAT WE RECOMMEND BE INCLUDED IN THE AGRICULTURE FOOD CLUSTER

From NACE division 01 Crop and animal production, hunting and related service activities

- ***From group 01.1 Growing of non-perennial crops***
  - 01.11 Growing of cereals (except rice), leguminous crops and oil seeds
  - 01.12 Growing of rice
  - 01.13 Growing of vegetables and melons, roots and tubers
  - 01.14 Growing of sugar cane
- ***From group 01.2 Growing of perennial crops***
  - 01.21 Growing of grapes
  - 01.22 Growing of tropical and subtropical fruits
  - 01.23 Growing of citrus fruits
  - 01.24 Growing of pome fruits and stone fruits
  - 01.25 Growing of other tree and bush fruits and nuts
  - 01.26 Growing of oleaginous fruits
  - 01.27 Growing of beverage crops
  - 01.28 Growing of spices, aromatic, drug and pharmaceutical crops
- ***From group 01.4 Animal production***
  - 01.41 Raising of dairy cattle
  - 01.42 Raising of other cattle and buffaloes
  - 01.45 Raising of sheep and goats
  - 01.46 Raising of swine/pigs
  - 01.5 Mixed farming
  - 01.50 Mixed farming
- ***From group 01.6 Support activities to agriculture and post-harvest crop activities***
  - 01.61 Support activities for crop production
  - 01.62 Support activities for animal production
  - 01.63 Post-harvest crop activities
  - 01.64 Seed processing for propagation
- ***From group 01.7 Hunting, trapping and related service activities***
- ***01.70 Hunting, trapping and related service activities***

From NACE division 03 Fishing and aquaculture

- ***From group 03.1 Fishing***
  - 03.11 Marine fishing
  - 03.12 Freshwater fishing
- ***From group 03.2 Aquaculture***
  - 03.21 Marine aquaculture
  - 03.22 Freshwater aquaculture

From NACE division 20 Manufacture of chemicals and chemical products

- *From group 20.2 Manufacture of pesticides and other agrochemical products*
  - 20.20 Manufacture of pesticides and other agrochemical products

From NACE division 28 Manufacture of machinery and equipment n.e.c.

- ***From group 28.3 Manufacture of agricultural and forestry machinery***
  - 28.30 Manufacture of agricultural and forestry machinery
- ***From group 46.1 Wholesale on a fee or contract basis***
  - 46.11 Agents involved in the sale of agricultural raw materials, live animals, textile raw materials and semi-finished goods

From NACE division 75 Veterinary activities

- ***From group 75.0 Veterinary activities***
  - 75.00 Veterinary activities
- ***From group 77.3 Renting and leasing of other machinery, equipment and tangible goods***
  - 77.31 Renting and leasing of agricultural machinery and equipment

4.2.2 MACHINERY AND EQUIPMENT FOR THE FOOD INDUSTRY

This group includes machinery and equipment for the food industry, for example, manufacture of agricultural dryers, machinery to clean, sort or grade seeds, machinery for the bakery industry or for making macaroni, spaghetti or similar products. It should also include manufacture of irradiation equipment, electromedical and electrotherapeutic equipment. Irradiation equipment is often used in food and milk production, but other industries use the equipment as well. Therefore, even though isolating the food-related production of irradiation equipment is preferable, it is unfortunately not possible. Following the logic from the ingredients discussion above we have chosen not to include NACE group 26.60, *Manufacture of irradiation, electromedical and electrotherapeutic equipment*. In the following table, the NACE classes belonging to the group *Machinery and equipment for the food industry* are listed according to our definition.

TABLE 6. NACE CLASS THAT WE RECOMMEND BE INCLUDED IN THE GROUP MACHINERY AND EQUIPMENT FOR THE FOOD INDUSTRY

From NACE division 28 Manufacture of machinery and equipment n.e.c.
• ***From group 28.9 Manufacture of other special-purpose machinery***
¤ 28.93 Manufacture of machinery for food, beverage and tobacco processing

4.3 SECOND LEVEL SUPPORT

Second level support companies are companies and organisations whose main activity is related to the divisions *Food industry core* and/or *First level support*.

The *second level support* division was defined by the expert group to consist of four different groups: *Transport and cargo, Packaging industry, Materials recovery* and *Wholesale food*. From all of these four groups, only food related activity should be included in the statistics.

4.3.1 TRANSPORT AND CARGO

The group *Transport and cargo* is involved in the whole food production chain and is therefore included in our definition of the food industry. In this report, we are focusing on freight transport of food by road. Freight transport by road accounts for 93% of all food-related transportation in Denmark and Sweden and for 73% of all food-related transportation within the agricultural sector. This group includes all freight transport operations by road, such as: refrigerated haulage, bulk haulage (including haulage in tanker trucks), milk collection at farms and transportation of waste and waste materials (without collection or disposal). The group also includes warehousing and storage, such as the operation of grain silos, blast freezing and cargo handling. Long distance transportation by sea or by air is not included in this report because it is too difficult to obtain accurate data on these forms of transportation. By contrast, the handling of cargo that is connected to transport by sea or air is included. The table below lists NACE groups to include in food industry statistics, although one must be aware that only a part is related to food industry as described below the table.

TABLE 7. NACE CLASSES THAT WE RECOMMEND BE INCLUDED IN THE GROUP TRANSPORT AND CARGO

From NACE division 49 Land transport and transport via pipelines
• *From group 49.4 Freight transport by road and removal services* ¤ 49.41 Freight transport by road ¤ 49.42 Removal services
From NACE division 52 Warehousing and support activities for transportation
• *From group 52.1 Warehousing and storage* ¤ 52.10 Warehousing and storage • *From group 52.2 Support activities for transportation* ¤ 52.21 Service activities incidental to land transportation ¤ 52.24 Cargo handling

With the help of secondary data, it is possible to isolate food-related transport and cargo[9] from other transport and cargo (see also Annex III). In Denmark, 40% of transport and cargo by road is food-related and in Sweden, 20% of transport and cargo by road is food-related. Note that in this report, regional information on food-related transport and cargo is an estimate based on this national data. The same percentages, 40% and 20%, will be applied at regional levels.

4.3.2 PACKAGING INDUSTRY

That packaging industry is part of the food industry is obvious. There are several packaging innovations that go hand in hand with the food industry. An example from the Øresund Region is Tetra Pak, which was founded in the 1940s as a result of an innovative packaging solution for the food industry. In 2008, the company was producing 141,379 billion Tetra Pak packages around the world.

The group *Packaging industry* includes production related to the final stage in the packaging industry, such as manufacture of containers of paper, plastic packing goods, hollow glass and light metal packaging. This division also includes packaging activities related to business support and machinery and equipment to the packaging industry.

In table 8, the NACE classes belonging to the group *Packaging industry* are listed according to our definition.

9 Danish Ministry of Transport, www.tm.dk; Swedish Institute for Transport and Communications Analysis [SIKA], www.sika-institute.se

TABLE 8. NACE CLASSES THAT WE RECOMMEND BE INCLUDED IN THE GROUP PACKAGING INDUSTRY

From NACE division 17 Manufacture of paper and paper products
• *From group 17.2 Manufacture of articles of paper and paperboard* ¤ 17.21 Manufacture of corrugated paper and paperboard and of containers ¤ 17.29 Manufacture of other articles of paper and paperboard
From NACE division 22 Manufacture of rubber and plastic products
• *From group 22.2 Manufacture of plastics products* ¤ 22.22 Manufacture of plastic packing goods
From NACE division 23 Manufacture of other non-metallic mineral products
• *From group 23.1 Manufacture of glass and glass products* ¤ 23.13 Manufacture of hollow glass
From NACE division 25 Manufacture of fabricated metal products, except machinery and Equipment
• *From group 25.9 Manufacture of other fabricated metal products* ¤ 25.92 Manufacture of light metal packaging
From NACE division 82 Office administrative, office support and other business support activities
• *From group 82.9 Business support service activities n.e.c.* ¤ 82.92 Packaging activities

Only a part of the packaging industry is food related, as was seen for *Transport and cargo*. Secondary data has provided us with the estimate that 54% of the world's packaging industry is food related[10]. This rough estimate is applied to our data knowing that it is not accurate to use at a regional level, and will most likely not reflect the real world in the Øresund Region. We hope that in the future it will be possible to isolate food-related packaging more accurately. See also Annex IV.

4.3.4 MATERIALS RECOVERY

The group *Materials recovery* includes the collection, treatment and disposal of waste materials. This also includes local hauling of waste materials and the operation of materials recovery facilities (i.e., those that sort recoverable materials from a waste stream).

The argument for including materials recovery as a part of the modern food industry is that this is part of the whole food value chain. According to the expert group, only food related materials recovery should be included.

Unfortunately, the statistics do not give us the possibility to isolate materials recovery activity related to food. The area is being investigated from different perspectives at the moment, and we recommend that if, in the future, activity related to food materials recovery can be found, it should be included in statistics. We suspect that *Materials Recovery* depends on factors such as population and population density and not on the size of the food industry, and therefore would belong to the *Independent operators* division. Nevertheless, materials recovery also covers the process of re-using waste from other industries,

10 *World Packaging Organisation, www.wpo.org*

for example, in packaging, making the group a supplier to the other divisions of the food industry. This would support that the group be included in second level supply.

How to include and whether the group *Materials recovery* belongs to the group *Second level supply* or *Independent operators* should, therefore, be determined through in-depth analysis of the field (see also Chapter 4.4).

At present, it is not possible to include *Materials recovery*, but below, in table 9, the NACE classes that we recommend be included in statistics once the food-related activity can be isolated, are listed.

TABLE 9. NACE CLASSES THAT WE RECOMMEND BE INCLUDED IN THE GROUP MATERIALS RECOVERY, WHEN THE FOOD RELATED ACTIVITY CAN BE ISOLATED

From NACE division 38 Waste collection, treatment and disposal activities; Materials Recovery
• ***From group 38.3 Materials recovery***   ¤ 38.32 Recovery of sorted materials

4.3.5 WHOLESALE FOOD

The group *Wholesale food* includes wholesale of food products, both imported and locally produced. The expert group included the group in the food industry cluster based on the argument that it contributes to the cluster in an important way with knowledge exchange. However, we find the group is not a good indicator for a cluster. This is because wholesale companies are often located at logistic hubs and not necessarily in geographical proximity to the cluster they supply, and because wholesalers are often also importers and handle goods supplied from outside the boundaries of a cluster. In other words, wholesale food functions independently from the core of the food cluster and depend rather on population, population density and logistics. Therefore, we find the group *Wholesale food* should be included in food industry statistics as a part of the division *Independent operators*, and not as part of the food industry cluster. In the table below, we have listed which NACE classes to include in the group *Wholesale food.*

TABLE 10. NACE CLASSES THAT WE RECOMMEND BE INCLUDED IN THE GROUP WHOLESALE FOOD

From NACE division 46 Wholesale trade, except of motor vehicles and motorcycles
• ***From group 46.1 Wholesale on a fee or contract basis***   ¤ 46.17 Agents involved in the sale of food, beverages and tobacco   • ***From group 46.3 Wholesale of food, beverages and tobacco***   ¤ 46.31 Wholesale of fruit and vegetables   ¤ 46.32 Wholesale of meat and meat products   ¤ 46.33 Wholesale of dairy products, eggs and edible oils and fats   ¤ 46.34 Wholesale of beverages   ¤ 46.36 Wholesale of sugar and chocolate and sugar confectionery   ¤ 46.37 Wholesale of coffee, tea, cocoa and spices   ¤ 46.38 Wholesale of other food, including fish, crustaceans and molluscs   ¤ 46.39 Non-specialised wholesale of food, beverages and tobacco

4.4 INDEPENDENT OPERATORS

When discussing the boundaries of the food industry with the expert group, the link between industry and consumers was discussed. This concerns, in particular, *Restaurant and catering* and *Retail*. They were put in the category *Independent operators* because their number and size are not related to the size and characteristics of the food industry, but rather depend on factors such as population and population density. The division *Independent operators* is not included in our food industry cluster statistics, but is included in the food industry statistics. Nevertheless, *Independent operators* are important to mention when discussing the food industry cluster, as they are important players in supporting innovation and development of the food industry cluster.

The division *Independent operators* consists of two different groups: *Restaurants and catering* and *Retail food*. These will not be described further, but the NACE-classes that we recommend to include in statistics covering the two groups are listed in the tables below.

TABLE 11. NACE CLASSES THAT WE RECOMMEND BE INCLUDED IN THE GROUP RESTAURANTS AND CATERING

From NACE division 56 Food and beverage service activities
• ***From group 56.1 Restaurants and mobile food service activities***
¤ 56.10 Restaurants and mobile food service activities

TABLE 12. NACE CLASSES THAT WE RECOMMEND BE INCLUDED IN THE GROUP RETAIL FOOD

From NACE division 47 Retail trade, except of motor vehicles and motorcycles
• ***From the group 47.1 Retail sale in non-specialised stores***
¤ Retail sale in non-specialised stores with food, beverages or tobacco predominating
• ***From the group 47.2 Retail sale of food, beverages and tobacco in specialised stores***
¤ 47.21 Retail sale of fruit and vegetables in specialised stores
¤ 47.22 Retail sale of meat and meat products in specialised stores
¤ 47.23 Retail sale of fish,
¤ crustaceans and molluscs in specialised stores
¤ 47.24 Retail sale of bread, cakes, flour confectionery....
¤ 47.25 Retail sale of beverages in specialised stores
¤ 47.29 Other retail sale of food in specialised stores

As mentioned above, we find that *Wholesales food* belongs within the division *Independent operators*, and that *Materials recovery* might belong here as well. However, a practical problem regarding *Materials recovery* occurs. If this group is included in food statistics, only food-related *Materials recovery* should be included and this isolation of activity is not possible today. This means that, in praxis, it is not possible to get a full overview over food-related materials recovery and we recommend that this is done **only** when this is possible in the future.

This division *Independent operators* could have included even more groups, such as business support companies, but because it is impossible to isolate food-related service companies within NACE codes, it cannot be done at this time.

5. REACHING THE NEW DEFINITION OF THE MODERN FOOD INDUSTRY

After thoroughly going through each part of the food industry, we now have a better picture of how to use official statistics to describe the modern food industry (see Annex I for a list of all NACE codes, that we have analysed). We will now sum up dilemmas and adjustments needed (as discussed in Chapter 4) and, based on these, suggest a new definition of the modern food industry. In Chapter 6, we will use the new definition to describe the modern food industry and food industry cluster in the Øresund Region.

5.1 ADJUSTMENTS

After analyzing each division and group, the dilemmas and needed adjustments for defining the food industry and the food industry cluster have become clearer, especially on three topics: ingredients industry identification, machinery and equipment industry and independent operators.

INGREDIENTS INDUSTRY IDENTIFICATION

Some of the NACE codes used in this report did not give us the information that we had hoped for. For example, Danisco and Chr. Hansen are included in NACE group 20.59 *Manufacture of other chemical products n.e.c.* In this NACE group, you will, for example, find companies that manufacture photographic plates, films, sensitised paper and other sensitised unexposed materials. Novozymes and other ingredients companies are included in NACE group 20.14 *Manufacture of other organic basic chemicals*. Therefore, it was difficult to isolate the companies that belonged to the food industry when we tried to group the ingredient industry into the two groups *Manufacture of food-related chemicals* and *Basic pharma*. It would be preferable to include food-related ingredients companies, not least when comparing internationally. Despite these difficulties, general conclusions can still be drawn for Denmark and Sweden, bearing in mind that the numbers of the food industry cluster are actually larger than represented in this report.

A way to include the ingredients industry in the future would be to use other (for instance, private) databases, as has been done for some reports on the subject[11]. The advantage of doing this would be to have a more precise picture of the ingredients industry, but the downside would be that other databases may not use international standards and are often not publicly available – and thus not verifiable.

MACHINERY AND EQUIPMENT INDUSTRY

A similar problem was experienced in the group *Machinery and equipment for the food industry*. It is not possible to only include irradiation equipment for food and drink production. There are no official statistics that indicate how much of the irradiation equipment is related

11 FORA's report "Den danske landbrugs- og fødevareklynge i et internationalt perspektiv" from February 2010 refers to data from Boston Monitor Group.

to food production. In this report we have chosen not to include NACE class 26.60 *Manufacture of irradiation equipment, electromedical and electrotherapeutic equipment.* But as mentioned in Chapter 4.2.2, if in the future it becomes possible to isolate the food related activity, it should be included.

INDEPENDENT OPERATORS

We suspect that the size and location of the group *Wholesale food* (included by the expert group in the division *Second level support*) depends not on the size, location and characteristics of the division *Food industry core*. Therefore we suggest including it in the division *Independent operators.*

For the time being, we recommend that *Material recovery* is left out of the statistics until further investigation of the field has taken place. Through in-depth analysis, it will, in the future, be possible to isolate food-related material recovery and to define whether it belongs in the division *Second level supply or Independent operators.*

5.2 THE NEW, MODIFIED MODEL TO DESCRIBE THE FOOD INDUSTRY

From the discussions in the previous chapters, we recommend adjusting the working model, which was constructed together with an expert group and which formed the basis of this report. We recommend using only the divisions we know provide us with useful data. Thus, we suggest a modified version of the model, which is illustrated in figure 4.

The modified model addresses both the food industry cluster and the food industry. The food industry cluster includes the groups: *Manufacture of food and beverages, Food service, Agriculture food cluster, Machinery and equipment for the food industry, Food-related transport and cargo*, and *Food-related packaging industry.* The modified model also includes: *Wholesale food, Retail food* and *Restaurant and catering* as independent operators, and thus a part of the food industry but not of the food industry cluster. The modified model does not include: *Manufacture of food-related chemicals, Basic pharma* and *Food-related materials recovery* because the current definition of the NACE codes makes it impossible to isolate food-related companies. Not all *Machinery and equipment for the food industry* is included in the model either, because it is currently impossible to isolate food-related activity.

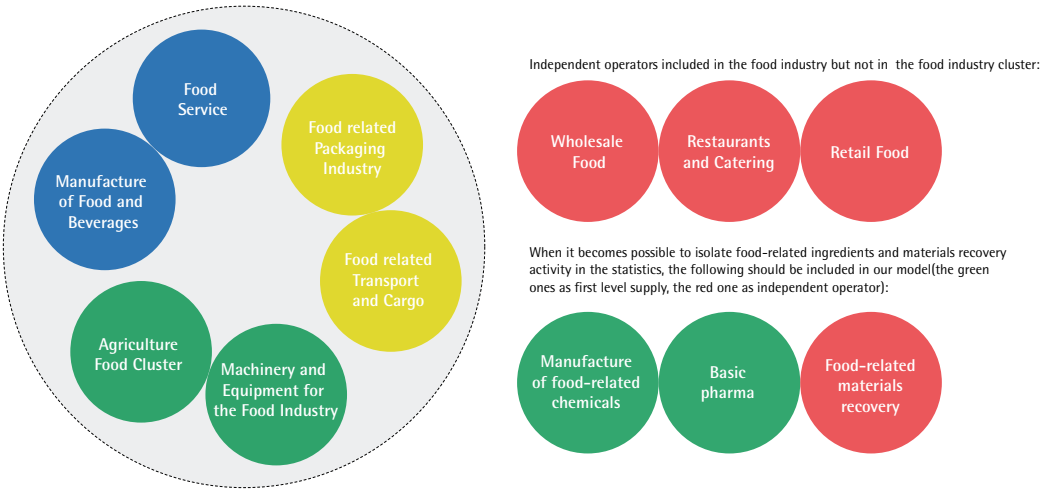


Figure 4. The new, modified model to describe the food industry. Blue labels represent industry groups belonging in the food industry core, green labels represent industry groups belonging in the first level supply, yellow labels represent industry groups belonging to second level supply, while red labels are the independent operators. The light blue circle defines the boundaries of the food industry cluster.

In conclusion, when using our new, modified model, statistics will give a more accurate, though not complete, picture of the food industry and the food industry cluster. This will make it easier to quantify and identify the geographical location and boundaries of food industry clusters for international comparisons. When the model is used, one should keep in mind that the numbers will be smaller than they are in reality because not all food-related activities are included, specifically not within ingredients, machinery and equipment and materials recovery.

In the following chapter, we will apply our new, modified model to the food industry in the Øresund Region. We will, in other words, present our approach to redefining the modern food industry – in in full scale, in real life and with real numbers.

6. THE FOOD INDUSTRY AROUND ØRESUND

Our statistical redefinition of the food industry makes it easier to make comparative analyses between countries or regions and to get an indication of whether a geographically defined area is a host of a food industry cluster or not. This is the purpose of the following chapter where we will test our new, modified model by applying to the food industry in the Øresund Region of Denmark and Sweden. The discussion will revolve around two major issues – the finding that the number of employees in the food industry cluster is more than double what it is generally perceived to be and the discussion about Denmark and Scania being complementary regions that embrace a complete food industry cluster.

6.1 THE FOOD INDUSTRY CLUSTER EMPLOYS MORE THAN DOUBLE THE NUMBER GENERALLY PERCEIVED

An overall statistical picture of the food industry in the Øresund Region is presented in table 13. In order to compile these statistics, we have added our new, modified model to the publicly available statistical data. The table follows our model in terms of structure and sums up the number of employees in the food industry cluster and the number of employees in the total food industry (including independent operators).

TABLE 13. NUMBER OF EMPLOYEES IN THE FOOD INDUSTRY BY DIVISION AND GROUP REPRESENTING DENMARK, SWEDEN, ZEALAND, SCANIA AND DENMARK + SCANIA. NUMBERS ARE GENERATED FROM OFFICIAL STATISTICS ACCORDING TO OUR MODEL DESCRIBED, ANALYSED AND DEFINED IN CHAPTERS 4 AND 5.

	Number of Empolyees					*Percent of the total workforce*				
	Denmark	**Sweden**	**Zealand**	**Scania**	**Denmark + Scania**	**Denmark**	**Sweden**	**Zealand**	**Scania**	**Denmark + Scania**
Food Industry Core										
Manufacture of Food and Beverages	69,904	57,953	19,354	12,597	82,501	2.5%	1.3%	1.5%	2.2%	2.4%
Food Service	10,580	6,890	6,638	672	11,252	0.4%	0.2%	0.5%	0.1%	0.3%
∑	**80,484**	**64,843**	**25,992**	**13,269**	**93,753**	**2.9%**	**1.4%**	**2.0%**	**2.3%**	**2.8%**
First Level Support										
Agriculture Food Cluster	48,729	41,520	8,068	8,296	57,025	1.7%	0.9%	0.6%	1.4%	1.7%
Machinery and Equipment for the Food Industry	4,768	1,263	1,591	832	5,600	0.2%	0.03%	0.1%	0.1%	0.2%
∑	**53,497**	**42,783**	**9,659**	**9,128**	**62,625**	**1.9%**	**0.9%**	**0.8%**	**1.6%**	**1.8%**
Second Level Support										
(Food related) Transport and Cargo	16,476	16,078	5,387	2,223	18,699	0.6%	0.4%	0.4%	0.4%	0.6%
(Food related) Packaging Industry	7,073	7,038	838	1,487	8,560	0.3%	0.2%	0.1%	0.3%	0.3%
∑	**23,549**	**23,116**	**6,225**	**3,710**	**27,259**	**0.8%**	**0.5%**	**0.5%**	**0.6%**	**0.8%**
∑ (Food Industry Cluster)	**157,530**	**130,742**	**41,876**	**26,107**	**183,637**	**5.6%**	**2.9%**	**3.3%**	**4.6%**	**5.4%**
Independent Operators										
Wholesale Food	20,438	29,445	9,484	4,979	25,417	0.7%	0.6%	0.7%	0.9%	0.7%
Retail Food	68,426	85,523	34,810	10,605	79,031	2.4%	1.9%	2.7%	1.9%	2.3%
Restaurants and Catering	50,690	81,658	24,504	9,683	60,373	1.8%	1.8%	1.9%	1.7%	1.8%
∑	**139,554**	**196,626**	**68,798**	**25,267**	**164,821**	**4.9%**	**4.3%**	**5.4%**	**4.4%**	**4.9%**
∑ (Food Industry Cluster + Independent Operators)	**297,084**	**327,368**	**110,674**	**51,374**	**348,458**	**10.5%**	**7.2%**	**8.6%**	**9.0%**	**10.3%**

Employment	Denmark	Sweden	Zealand	Scania
total workforce	2,821,641	4,540,675	1, 81,800	573,175
percent of population	51.8 %	48.2%	52.3%	48.8%

a) See Chapter 4.2.1 for a detailed overview over what is included in the agriculture food cluster

b) The food-related transport and cargo at a regional level has been estimated with the help of data for food-related transport and cargo at a national level (DK 40% and S 20%), since regional data does not exist.

c) The food-related packaging industry at a regional level has been estimated with the help of global data, since regional data does not exist. 54% of the total production of packaging in the world is estimated to be used for food and beverage.

An important finding from our redefinition of the food industry, which can be seen in table 13, is that the food industry cluster in Denmark employs around 158,000 people, which is more than double the 70,000 generated by using the standard definition *Manufacture of food and beverages*. The same goes for Sweden, in which the food industry cluster employs around 131,000 people, more than double the 58,000 employed according to the traditional definition.

As mentioned earlier, one of the basics when discussing clusters is that there should be a certain critical mass within a geographically defined area. Our re-defined numbers give a more correct picture of employment related to the food industry than has been represented by other statistics. And this is despite the fact that the numbers are most probably lower than in reality since relevant manufacturers, for example, ingredient manufacturers and irradiation equipment manufacturers, could not be included due to limitations imposed by current NACE group definitions.

The food industry cluster in Denmark employs 5.6% of the workforce while the Swedish food industry cluster employs 2.9%. The Danish+Scanian workforce employs 5.4%, which is very close to the Danish number. If we also include the division *Independent operators*, the total food industry employs over 10% of the Danish workforce and around 7.2% of the Swedish workforce. These numbers underscore the importance of the food industry in the Øresund Region.

If we had chosen to use other definitions of "the modern food industry," we would get very different pictures. Using the European Cluster Observatory definition, we could only include the group *Manufacturing of food and beverages*. This group accounts only for 2.5% of the workforce in Denmark and 1.3% of the workforce in Sweden. If we instead use the definition that Eurostat is using in "Food: From farm to fork statistics," the picture would be better, but also incomplete. It would miss out on several key areas, such as *Machinery and equipment for the food industry, Transport and cargo* and *Packaging industry*, but on the other hand include some independent operators that in our model do not belong to the cluster. The food employment as a percentage of the total employment in Denmark would be 9.3 while in Sweden, it would be 6.8[12].

Table 14 shows the number of employees in each group as compared to the entire food industry cluster. From these figures, it becomes clear that *Manufacture of food and beverages* and *Agriculture food cluster* are much larger than the others, no matter which geographical area we look at. For instance, in Denmark+Scania 44.9% and 31.1% of the employees in the entire food industry cluster work within *Manufacture of food and beverages* and *Agriculture food cluster*, respectively. This highlights that these two sectors are the backbone of the food industry. These two groups can be expected to have the greatest influence on what the food industry as a whole looks like in different parts of the world.

12 See Annex V for the calculations we have made from official statistics based on the Eurostat definitions.

TABLE 14. EMPLOYEES AS A PERCENTAGE OF THE FOOD INDUSTRY CLUSTER IN EACH COUNTRY/REGION. NUMBERS ARE GENERATED FROM OFFICIAL STATISTICS ACCORDING TO OUR MODEL DESCRIBED, ANALYSED AND DEFINED IN CHAPTERS 4 AND 5.

	Employees as a percentage of the food industry cluster in the specific region				
	Denmark	**Sweden**	**Zealand**	**Scania**	**Denmark + Scania**
Food Industry Core					
Manufacture of Food and Beverages	44.4%	44.3%	46.2%	48.3%	44.9%
Food Service	6.7%	5.3%	15.9%	2.6%	6.1%
∑	**51.1%**	**49.6%**	**62.1%**	**50.8%**	**51.1%**
First Level Support					
Agriculture Food Cluster*	30.9%	31.8%	19.3%	31.8%	31.1%
Machinery and Equipment for the Food Industry	3.0%	1.0%	3.8%	3.2%	3.0%
∑	**34.0%**	**32.7%**	**23.1%**	**35.0%**	**34.1%**
Second Level Support					
(Food related) Transport and Cargo	10.5%	12.3%	12.9%	8.5%	10.2%
(Food related) Packaging Industry	4.5%	5.4%	2.0%	5.7%	4.7%
∑	**14.9%**	**17.7%**	**14.9%**	**14.2%**	**14.8%**
∑ (Food Industry Cluster)	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

*See chapter 4.2.1 for a detailed explanation of what is included in the agriculture food cluster

It has already been stated elsewhere by studies, reports and stakeholders including the European Cluster Observatory that there is a large and important food cluster in Denmark[13]. Our statistics support this conclusion.

Table 13 clearly shows that the Danish food industry cluster employs more people in absolute numbers than the Swedish, and that the Danish cluster employs a larger percentage of the total workforce than the Swedish. This supports what previous reports have concluded: that the food industry is more important to the Danish economy than to the Swedish. The data is, however, limited by the fact that only two similar countries are compared and in that it is only based on number of employees. The numbers cannot tell us how the two countries rank at a global level. For this, a real international benchmarking is necessary. To accomplish this, our model can be used to extract data about other potential food industry clusters around the world.

THE ØRESUND REGION COMPARED WITH NATIONAL DATA

When we look at data at a regional level in Table 13, we must bear in mind that confidentiality rules give the numbers higher uncertainty than at a national level. In addition, we know

13 European Cluster Observatory - www.clusterobservatory.eu,; Region Scania - www.skane.se; Food Innovation Network Europe - www.networkfine.net

the numbers do not include important ingredients companies in the Zealand Region (see Annex II). Nevertheless, we will take a closer look at what the numbers show.

Table 13 shows that the food industry cluster in Zealand employs a smaller percentage of the workforce than in Denmark as a whole. It also shows that each of the groups within the food industry cluster make up a smaller percentage of the workforce compared with all of Denmark, except in the group *Food service*. This indicates that Zealand plays only a small role in the food industry cluster in Denmark. But, knowing that the ingredients industry is poorly represented in the report, the picture is probably not entirely accurate as the large ingredients companies are located in the Zealand Region. Additionally, food-related irradiation equipment could not be included due to NACE definitions. From the presently available data, Zealand cannot be considered an independent food industry cluster, but Denmark can.

As for the region Scania, the picture is slightly different. The employment percentages indicate that Scania is a food producing area of Sweden, since the employment percentage is higher in the groups *Manufacture of food and beverages, Agriculture food cluster, Machinery and equipment for the food industry* and *Food-related packaging industry*. On the other hand, the employment percentage in *Food service* is lower in Scania. With regards to *Packaging industry*, the employment percentage does not reflect reality because confidentiality rules and diversified product portfolios can leave out major players; for example, major players in the packaging industry in Scania may be included in *Machinery and equipment* instead of *Packaging industry*. We are hesitant to call Scania an important, international food industry cluster as the total employment in absolute numbers is quite small on an international scale. In cluster theory, some critical mass is necessary to regard an area as a cluster[14]. Instead, we find it highly relevant to include Scania as a part of a larger food industry cluster that stretches over Denmark and Scania. This will be expanded upon below.

6.2 DENMARK AND SCANIA EMBRACE A COMPLETE FOOD INDUSTRY CLUSTER

We regard Denmark and Scania as a complete food industry cluster. Denmark and Denmark+Scania have similar proportions of employees in the food industry cluster (see table 13). Figure 3 represents this graphically, showing the accumulated percentage of the total workforce in the mentioned industries in Denmark, Sweden and Denmark+Scania. Each time you move one dot to your right, you add the next industry. To give an example, the first dot on the blue line represents the percentage of the Swedish workforce that works within *Manufacture of food and beverages*, while the fourth dot on the same line shows the percentage of the Swedish workforce that works within the food industry core *and* first level support.

14 Porter, Michael E. "Clusters and the New Economics of Competition." Harvard Business Review. November/December 1998.

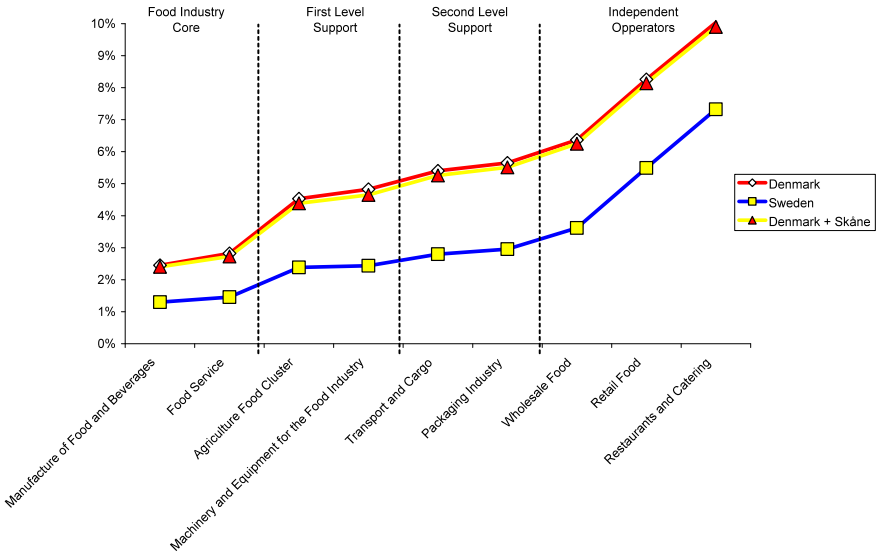


Figure 5. Accumulated percentage of total workforce in Denmark, Sweden and Denmark+Scania within the food industry cluster (food industry core + first level support + second level support) and the total food industry (food industry cluster + independent operators)

Figure 5 shows very clearly that the percentage of employees in the food industry in Denmark and Denmark+Scania is almost identical and approximately double the percentage seen for Sweden.

As previously mentioned, there is a big and important food industry cluster in Denmark. Yet we find that several factors indicate that Danish/Swedish collaboration cannot be ignored. We argue that Scania and Denmark are complementary and embrace a complete food industry cluster. For instance, large food companies like Lantmännen and Arla Foods are fusions between companies from both countries, and the Swedish and Danish markets have become the home market for companies on both sides of the Øresund street.

This view is supported in the second part of this report "Part II: Redefining the food sector. Food research, education and collaboration in the Øresund Region". Part II shows not only the broadness and quality of the research in the Øresund Region of Denmark and Sweden but also the complementarities, specifically of research agendas. For instance, no research is currently being done on packaging in Denmark, while important research and development is taking place in Lund in Scania.

7. CONCLUSION

The food sector in the Øresund Region is large and comprehensive. With this report, we have taken the first steps towards creating new guidelines for what to include when talking about the modern food industry and we have investigated if it is possible to describe the modern food industry by re-grouping official statistics. We have also taken a closer look at the modern food industry in Denmark and Sweden and the Øresund Region, which connects these two countries. The Øresund Region is, in this report, considered to be Denmark and Scania, since neither Zealand nor Scania can be viewed as individual food industry clusters.

Our new definition for the modern food industry includes not only the traditional areas of the food industry, but also industries and disciplines that have a strong link to or act in symbiosis with the food industry. When using this model, statistics will give a more accurate, though not complete, picture of the food industry and the food industry cluster than we have today. It allows for easier quantification and identification of the geographic location and boundaries of food industry clusters for international comparisons. Our model is a first step towards a more accurate quantification of the modern food industry and better opportunities for correct comparisons and international benchmarking.

Our new definition distinguishes between the food industry cluster and the food industry.

The food industry cluster includes:

- Food industry core: Manufacture of food and beverages; Food service
- First level support: Agriculture food cluster; Machinery and equipment for the food industry
- Second level support: Food-related transport and cargo; Food-related packaging industry

The food industry includes:

- Food industry cluster
- Independent operators: Wholesale food; Retail food; Restaurant and catering

When our model is used, one should keep in mind that the numbers will still be smaller than in reality, because not all food-related activities are included. This applies specifically within *Ingredients, Machinery and equipment,* and *Materials recovery*, where the current definition of NACE codes makes it impossible to isolate food-related companies. It is very important that these food-related activities are included in future statistics in order to provide an accurate picture of the modern food industry. We encourage the statistical bureaus to make this possible in the near future.

The modern food industry in the Øresund Region is much larger than anticipated, and Denmark and Scania seem to be complementing each other and embracing a complete food industry cluster. The food industry cluster in Denmark employs around 158,000 people, which is more than double the 70,000 working in the cluster according to the traditional definition. The same applies in Sweden, where the food industry cluster employs around 131,000

people, more than double the 58,000 employed according to the traditional definition. The numbers may indeed be even higher due to the limitations of extracting statistical data for food-related ingredient and irradiation equipment companies.

When compared to the total workforce, the importance of the food industry is also highlighted. The food industry cluster in Denmark employs 5.6% of the workforce while the Swedish food industry cluster employs 2.9%. The Danish+Scanian workforce employs 5.4%. If independent operators are also included, the total food industry employs over 10% of the Danish workforce, 7.2% of the Swedish workforce, and more than 10% of the Danish+Scanian workforce. These numbers are much higher than previously estimated. Note that only employees from the private food sector are included.

As suspected, the groups *Manufacture of food and beverages* and *Agriculture food cluster* employ the most people within the food industry cluster (in Denmark+Scania 44.9% and 31.1%, respectively). When making international comparisons these two groups can be expected to have the greatest influence on what the food industry as a whole looks like in different parts of the world.

8. HOW TO CONTINUE

We hope that our re-definition of the modern food industry will attract attention and become widely accepted by relevant stakeholders in Denmark and Sweden. It is a great opportunity for our countries and regions to be able to promote our comprehensive food industry cluster more accurately, both nationally and internationally.

The next step could be to use our new definition of the modern food industry to compare different regions or countries around the world. In this respect, it is important to highlight that we have, in this report, looked at employment in two countries with very similar structures when it comes to education, technology and industrial progress. In less industrially developed countries, a larger part of the workforce is employed in labour intensive food production as compared with more developed countries, and great differences in industrial development are likely to occur. We suggest that employment statistics be supplied along with other indicators of a cluster to give a more comprehensive picture of a cluster and suggest, when possible, to include:

Importance of the food industry

- Percent of total workforce
- Percent of total export
- Percent of total turnover

Performance of the food industry

- Turnover and added value per employee
- Number of employees per company
- Level of education and wages

It is hard to get complete data on the indicators presented above if we look at regional data, mainly due to confidentiality rules and not being able to extract full, existing NACE divisions or groups containing food industry companies, but rather, being restricted to selecting NACE classes. Therefore, it would be difficult to develop a universal model, where *all* information is included, that could be used when analysing the food industry.

However, by using our modified model and using the above-mentioned indicators (the importance and performance of the industry), it will be possible to compare food industry clusters in different regions around the world from official statistics. If the various indicators are summed up according to the three divisions *Food industry core, First level supply* and *Second level supply*, we will not only get a picture of how important the food industry is and how well it performs; we will also get a picture of how the industry is set up and how large the support industries are.

Even if our redefined model is used and gives a better picture of the modern world as of today, it still lacks information on relevant industries, mainly ingredients industry and materials recovery. As the statistical reporting system is today, we unfortunately need to exclude some parts of the food industry due to difficulties in isolating them within the

statistical data. This means that today, a statistical set of data extracted from official statistics should be supplied with secondary analysis of other relevant industries in the region to estimate the impact they have on the food industry and if and how to include them. At the same time, statistical bureaus should be encouraged to make it possible to extract this food-related information from the statistics in the near future, preferably by re-grouping the NACE codes.

ANNEX

ANNEX I: NACE CODES INCLUDED IN THIS REPORT

The NACE codes below cover ALL analysed groups in this report. The NACE codes mentioned in the report above only represent those we find should be included when generating statistics on the food industry.

Categorized by group

MANUFACTURE OF FOOD & BEVERAGES

10 Manufacture of food products

10.1 Processing and preserving of meat and production of meat products

10.11 Processing and preserving of meat

10.12 Processing and preserving of poultry meat

10.13 Production of meat and poultry meat products

10.2 Processing and preserving of fish, crustaceans and molluscs

10.20 Processing and preserving of fish, crustaceans and molluscs

10.3 Processing and preserving of fruit and vegetables

10.31 Processing and preserving of potatoes

10.32 Manufacture of fruit and vegetable juice

10.39 Other processing and preserving of fruit and vegetables

10.4 Manufacture of vegetable and animal oils and fats

10.41 Manufacture of oils and fats

10.42 Manufacture of margarine and similar edible fats

10.5 Manufacture of dairy products

10.51 Operation of dairies and cheese making

10.52 Manufacture of ice cream

10.6 Manufacture of grain mill products, starches and starch products

10.61 Manufacture of grain mill products

10.62 Manufacture of starches and starch products

10.7 Manufacture of bakery and farinaceous products

10.71 Manufacture of bread; manufacture of fresh pastry goods and cakes

10.72 Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes

10.73 Manufacture of macaroni, noodles, couscous and similar farinaceous products

10.8 Manufacture of other food products

10.81 Manufacture of sugar

10.82 Manufacture of cocoa, chocolate and sugar confectionery

10.83 Processing of tea and coffee

10.84 Manufacture of condiments and seasonings

10.85 Manufacture of prepared meals and dishes

10.86 Manufacture of homogenised food preparations and dietetic food

10.89 Manufacture of other food products n.e.c.

10.9 Manufacture of prepared animal feeds

10.91 Manufacture of prepared feeds for farm animals

10.92 Manufacture of prepared pet foods

11 Manufacture of beverages

11.0 Manufacture of beverages

11.01 Distilling, rectifying and blending of spirits

11.02 Manufacture of wine from grape

11.03 Manufacture of cider and other fruit wines

11.04 Manufacture of other non-distilled fermented beverages

11.05 Manufacture of beer

11.06 Manufacture of malt

11.07 Manufacture of soft drinks; production of mineral waters and other bottled waters

FOOD SERVICE

56 Food and beverage service activities

56.2 Event catering and other Food Service activities

56.21 Event catering activities

56.29 Other Food Service activities

MANUFACTURE OF FOOD-RELATED CHEMICALS

20 Manufacture of chemicals and chemical products

20.1 Manufacture of basic chemicals...

20.14 Manufacture of other organic basic chemicals

20.5 Manufacture of other chemical products

20.53 Manufacture of essential oils

20.59 Manufacture of other chemical products n.e.c.

BASIC PHARMA

21 Manufacture of Basic Pharmaceutical products and pharmaceutical preparations

21.1 Manufacture of Basic Pharmaceutical products

21.10 Manufacture of Basic Pharmaceutical products

AGRICULTURE FOOD CLUSTER

01 Crop and animal production, hunting and related service activities

01.1 Growing of non-perennial crops

01.11 Growing of cereals (except rice), leguminous crops and oil seeds

01.12 Growing of rice

01.13 Growing of vegetables and melons, roots and tubers

01.14 Growing of sugar cane

01.2 Growing of perennial crops

01.21 Growing of grapes

01.22 Growing of tropical and subtropical fruits

01.23 Growing of citrus fruits

01.24 Growing of pome fruits and stone fruits

01.25 Growing of other tree and bush fruits and nuts

01.26 Growing of oleaginous fruits

01.27 Growing of beverage crops

01.28 Growing of spices, aromatic, drug and pharmaceutical crops

01.4 Animal production

01.41 Raising of dairy cattle

01.42 Raising of other cattle and buffaloes

01.45 Raising of sheep and goats

01.46 Raising of swine/pigs

01.5 Mixed farming

01.50 Mixed farming

01.6 Support activities to agriculture and post-harvest crop activities

01.61 Support activities for crop production

01.62 Support activities for animal production

01.63 Post-harvest crop activities

01.64 Seed processing for propagation

01.7 Hunting, trapping and related service activities

01.70 Hunting, trapping and related service activities

03 Fishing and aquaculture

03.1 Fishing

03.11 Marine fishing

03.12 Freshwater fishing

03.2 Aquaculture

03.21 Marine aquaculture

03.22 Freshwater aquaculture

20 Manufacture of chemicals and chemical products

20.2 Manufacture of pesticides and other agrochemical products

20.20 Manufacture of pesticides and other agrochemical products

28 Manufacture of machinery and equipment n.e.c.

28.3 Manufacture of agricultural and forestry machinery

28.30 Manufacture of agricultural and forestry machinery

46.1 Wholesale on a fee or contract basis

46.11 Agents involved in the sale of agricultural raw materials, live animals, textile raw materials and semi-finished goods

75 Veterinary activities

75.0 Veterinary activities

75.00 Veterinary activities

77.3 Renting and leasing of other machinery, equipment and tangible goods

77.31 Renting and leasing of agricultural machinery and equipment

MACHINERY AND EQUIPMENT FOR THE FOOD INDUSTRY

26 Manufacture of computer, electronic and optical products

26.6 Manufacture of irradiation, electromedical and electro-therapeutic equipment

26.60 Manufacture of irradiation, electromedical and electro-therapeutic equipment

28 Manufacture of machinery and equipment n.e.c.

28.9 Manufacture of other special-purpose machinery

28.93 Manufacture of machinery for food, beverage and tobacco processing

TRANSPORT AND CARGO

49 Land transport and transport via pipelines

49.4 Freight transport by road and removal services

49.41 Freight transport by road

49.42 Removal services

52 Warehousing and support activities for transportation

52.1 Warehousing and storage

52.10 Warehousing and storage

52.2 Support activities for transportation

52.21 Service activities incidental to land transportation

52.24 Cargo handling

PACKAGING INDUSTRY

17 Manufacture of paper and paper products

17.2 Manufacture of articles of paper and paperboard

17.21 Manufacture of corrugated paper and paperboard and of containers...

17.29 Manufacture of other articles of paper and paperboard

22 Manufacture of rubber and plastic products

22.2 Manufacture of plastics products

22.22 Manufacture of plastic packing goods

23 Manufacture of other non-metallic mineral products

23.1 Manufacture of glass and glass products

23.13 Manufacture of hollow glass

25 Manufacture of fabricated metal products, except machinery and Equipment

25.9 Manufacture of other fabricated metal products

25.92 Manufacture of light metal packaging

82 Office administrative, office support and other business support activities

82.9 Business support service activities n.e.c.

82.92 Packaging activities

WHOLESALE FOOD

46 Wholesale trade, except of motor vehicles and motorcycles

46.1 Wholesale on a fee or contract basis

46.17 Agents involved in the sale of food, beverages and tobacco

46.3 Wholesale of food, beverages and tobacco

46.31 Wholesale of fruit and vegetables

46.32 Wholesale of meat and meat products

46.33 Wholesale of dairy products, eggs and edible oils and fats

46.34 Wholesale of beverages

46.36 Wholesale of sugar and chocolate and sugar confectionery

46.37 Wholesale of coffee, tea, cocoa and spices

46.38 Wholesale of other food, including fish, crustaceans and molluscs

46.39 Non-specialised wholesale of food, beverages and tobacco

MATERIALS RECOVERY

38 Waste collection, treatment and disposal activities; Materials Recovery

38.3 Materials recovery

38.32 Recovery of sorted materials

RETAIL FOOD

47 Retail trade, except of motor vehicles and motorcycles

47.1 Retail sale in non-specialised stores

47.11 Retail sale in non-specialised stores with food, beverages

47.2 Retail sale of food, beverages and tobacco in specialised stores

47.21 Retail sale of fruit and vegetables in specialised stores

47.22 Retail sale of meat and meat products in specialised stores

47.23 Retail sale of fish, crustaceans and molluscs in specialised stores

47.24 Retail sale of bread, cakes, flour confectionery...

47.25 Retail sale of beverages in specialised stores

47.29 Other retail sale of food in specialised stores

RESTAURANT

56 Food and beverage service activities

56.1 Restaurants and mobile Food Service activities

56.10 Restaurants and mobile food service activities

ANNEX II: INFORMATION RELATED TO INGREDIENTS INDUSTRY

CHR. HANSEN

NACE-code:	20.59.00	Manufacture of other chemical products n.e.c (not elsewhere classified).
Employees in Denmark:	950	
Employees in Sweden:	none	

(Information: Communications dep., Chr.Hansen)

DANISCO

NACE-code:	20.59.00	Manufacture of other chemical products n.e.c
Employees in Denmark:	1,300	
Sweden:	Only sales dep, probably less than 10	

(Information: www.danisco.com)

NOVO NORDISK

NACE-code:	21.20.00	Manufacture of pharmaceutical preparations
Employees in Denmark:	13,000	Of these, we do not know how many work in
Employees in Sweden:	90	food-related business.

(Information: www.novonordisk.dk, www.novonordisk.se)

NOVOZYMES

NACE-code:	20.14.00	Manufacture of other organic basic chemicals
Employees in Denmark:	2,400	Of these, we do not know how many work in
Employees in Sweden:	90	food-related business.

(Information: www.novozymes.com, Communications dep., Novozymes)

ANNEX III: SECONDARY DATA FOR DEFINING FOOD-RELATED TRANSPORT AND CARGO

Below, the calculation of the quotas of food-related transport is explained. The numbers in the tables have been provided by the Danish Ministry of Transportation and the Swedish Institute for Transport and Communications Analysis, which use the traditional definition of the food industry, which is why tobacco, for instance, is included. The numbers reflect our best alternative and we have therefore chosen to use them despite this inaccuracy.

In Denmark, the food-related transport as a proportion of all freight transport by road corresponds to approximately 40% (4,530/11,495). Approximately 20% of all freight transport by road in Sweden is related to the food industry (7,514/37,934).

Denmark	
Agricultural product (excl. non-food)	1,513
Food, beverages and tobacco	3,017
Σ (Food-related transport in Denmark)	4,530
All freight transport by road in Denmark	11,495

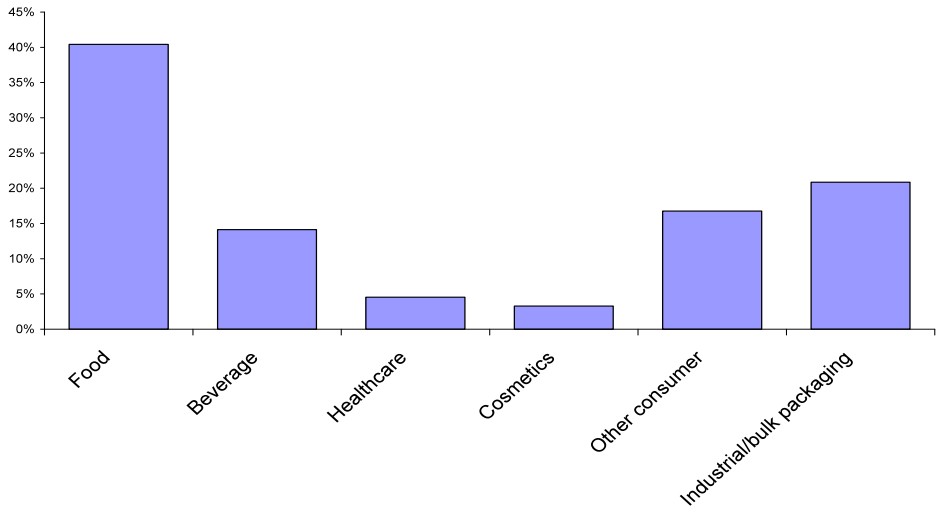
Sweden	
Agricultural product (excl. non-food)	1,681
Food, beverages and tobacco	5,833
Σ (Food-related transport in Sweden)	7,514
All freight transport by road in Sweden	37,934

In Sweden, a lot of non-food agricultural transports, such as wood products, in the group *Agricultural food cluster* could be included considering their importance for the packaging industry, but due to the restrictions we described earlier, they are excluded.

ANNEX IV: SECONDARY DATA FOR DEFINING FOOD-RELATED PACKAGING INDUSTRY

Of the total production of packaging in the world, 54% is used for food and beverages, as can be seen in figure 4 (40% food + 14% beverages).

PACKAGING CONSUMPTION BY END-USE MARKET (GLOBALLY)



SOURCE: WORLD PACKAGING ORGANISATION WWW.WPO.ORG

ANNEX V: EMPLOYEES IN THE FOOD INDUSTRY USING THE EUROSTAT DEFINITIONS OF "FOOD: FROM FARM TO FORK STATISTICS"

The tables below show our calculations generated from the official statistics, based on the Eurostat's definitions of the food industry, which differ from our definition in that, for instance, they include retail, restaurants and catering.

NUMBER OF EMPLOYEES IN THE FOOD INDUSTRY IN DENMARK, SWEDEN, ZEALAND AND SCANIA USING THE EUROSTAT DEFINITION OF "FOOD: FROM FARM TO FORK STATISTICS"

	NUMBER OF EMPOLYEES			
	Denmark	**Sweden**	**Zealand**	**Scania**
Farm production stage (Agriculture and Aquaculture)	41,438	47,404	7,720	9,041
Processing stage (Manufacture of Food and Beverages)	69,904	57,953	19,354	12,597
Distribution stage (Wholesale, Retail, Restaurants and Catering)	149,621	201,803	82,204	26,339
Σ	**260,963**	**307,160**	**109,278**	**47,977**

EMPLOYEES IN THE FOOD INDUSTRY AS A PERCENTAGE OF THE TOTAL WORKFORCE IN DENMARK, SWEDEN, SCANIA AND ZEALAND USING THE EUROSTAT DEFINITION OF "FOOD: FROM FARM TO FORK STATISTICS"

	PERCENT OF THE TOTAL WORKFORCE			
	Denmark	**Sweden**	**Zealand**	**Scania**
Farm production stage (Agriculture and Aquaculture)	1.5%	1.0%	0.6%	1.6%
Processing stage (Manufacture of Food and Beverages)	2.5%	1.3%	1.5%	2.2%
Distribution stage (Wholesale, Retail, Restaurants and Catering)	5.3%	4.4%	6.4%	4.6%
Σ	**9.3%**	**6.8%**	**8.5%**	**8.4%**

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Food Innovation Network Europe, www.networkfine.net

Region Scania, www.skane.se

Statens institut för kommunikationsanalys, www.sika-institute.se

Transportministeriet, www.tm.dk,

World Packaging Organisation, www.worldpackaging.org

PART II

REDEFINING THE FOOD SECTOR: FOOD RESEARCH, EDUCATION AND COLLABORATION IN THE ØRESUND REGION

1. INTRODUCTION

AIM AND FOCUS OF THE REPORT

This second part of the report "Redefining the food sector in the Øresund Region" focuses on food-related research, educational programmes and courses, as well as innovation-supportive organisations, science parks, incubators and food networks. The entire food value chain is in focus – from soil/sea to the table/consumer and back to soil/sea again. The overall aim is to present a redefinition of food studies by broadening the food definition to include this entire food value chain, and to create an overview of the region's food-related research, education and collaborations in both a qualitative and quantitative manner.

This report is not meant to give the full picture, but will illustrate the diversity of ongoing research, education and collaborative activity in relation to food in the Øresund Region.

DEFINITION OF INCLUDED UNIVERSITIES AND UNIVERSITY COLLEGES

The food-related research and education presented in this report is being carried out at universities and university colleges in the Øresund Region[1]. Specific focus is on Øresund University, which during the data collection period was an association of nine universities and university colleges in the Øresund Region:

- Copenhagen Business School (CBS)
- Kristianstad University (HKR)
- Malmö University (MAH)
- Roskilde University (RUC)
- Royal Danish Academy of Fine Arts, School of Architecture (KA)
- Technical University of Denmark (DTU)
- The Swedish University of Agriculture (SLU)
- University of Copenhagen (KU)
- University of Lund (LU)

It is important to stress that food research and educational programmes and courses also take place at universities and university colleges in other parts of Denmark and Sweden. These may be mentioned, but not described, in this report as our primary focus is on Øresund University and the Øresund Region. Courses offered by the above-mentioned universities to industry are similarly not included in this investigation[2]. In addition, the vast amount of research conducted in private companies is not included in this report.

1 In this report, the Øresund Region is defined as the region Zealand and the Capital Region in Denmark and Scania in Sweden. These are connected by the Øresund Bridge.

2 An inventory of these courses was made by Øresund Food in 2009 under the baltfood project.

FOCUS ON THE WHOLE FOOD VALUE CHAIN

This report is structured along the entire food value chain due to the great complexity of the food field. Food research addresses questions that are often impossible to answer within one single discipline. This is reflected in interdisciplinary educational programmes as well as in research projects and networks. Traditionally, food studies have been closely related to disciplines of technology and natural sciences at universities. However, food is not only a research and educational subject within its own, distinct discipline; it utilises and constitutes an integrated part of many disciplines as well as a variety of projects. The diversity in the field of food is enormous and covers the whole range from microbiology, micronutrients, nutrition and technology, through logistics, design and management, all the way to consumer preferences, food sustainability, and further on to waste management.

DEFINITION OF FOOD AND FOOD STUDIES

It is necessary and important to work with a wide definition of food and food studies in order to present a fair picture of relevant activities being carried out and to accurately conceptualise the complex area of food. In Denmark, the Ministry of Food, Agriculture and Fisheries has presented the following definition of food research (in Danish):

> *Ved fødevareforskning forstås forskning, der knytter sig til produktion og forbrug af fødevarer og nonfoodprodukter fra landbrugs-, gartneri- og fiskerisektoren spændende fra råvareproduktion over forarbejdning, handel og distribution til forbrugeren samt de afledte konsekvenser heraf.*

The definition includes production and consumption of food and non-food from agriculture, horticulture and the fishery sector, from primary production to processing, marketing and distribution, and further on to the consumer and secondary consequences. Using this definition enables us to include research projects within a wide range of disciplines in our examination and redefinition of the food sector.

EXISTING OVERVIEWS OF RESEARCH IN DENMARK AND SWEDEN

It is important to highlight that the present report cannot stand alone, and that it merely gives an illustration of the diversity of food-related research and educational activity in the Øresund Region. Other overviews of food research have also been performed in Denmark and Sweden; it is recommended that these be read in conjunction with this report to fill in any gaps that each report may leave.

An evaluation of Danish food-related research was performed in 2008 by the Centre for Advanced Food Studies (LMC) in Denmark, a collaboration between the universities in Denmark that focus on food. An international advisory board evaluated 31 research groups, who had all initially conducted self-evaluations of their respective research activities. This phase was followed by groups of experts making visits to the institutes. In this evaluation, primary production, research conducted at institutes of social and cultural sciences, and research activities at, for example, Copenhagen Business School were not included.

At the University of Lund in Sweden, a self-evaluation was also conducted in 2008 by the Research Quality Evaluation for the Future (RQ08)[3], with the aim of strengthening the research quality at the university. An evaluation process has also been undergone at the Swedish University of Agricultural Sciences (SLU) in Sweden in 2008, primarily based on self-evaluation. However, these were general evaluations of research activities and not specified on food science. As pointed out earlier, this present report is not an evaluation, but a presentation of the diversity of the field of food in the Øresund Region.

In early 2009, the Danish Agency for Science, Technology and Innovation had the EU Commission evaluate research on food in Denmark. The main purpose was to present research activity within the food sector as well as to evaluate the quality of the research conducted, allowing the food industry to better plan for and prioritise in the future. However, a preliminary investigation/inquiry conducted in spring 2009 emphasized not only that the food research area was massive, important and of high quality, but also that instead of an actual evaluation, there was a need for mapping the Danish food research with special focus on extensions and proportions, co-operations, research profiles and international perspectives. This mapping was expected to be published in March/April 2010, and the results were meant to be included as material in the present report. At the time of completing the study material for this report, however, these results were unfortunately not available; when available, highlights from the Danish Agency for Science, Technology and Innovation report will be added.

3 The full report can be found at:
http://www.lu.se/lund-university/research/research-evaluation---RQ08

2. MATERIALS AND METHODS

COLLECTION OF DATA

The data for this report was collected from August 2009 until February 2010 and consists of printed materials such as annual reports and materials from websites[4]. Besides the website of individual institutes, important information has also been obtained from various web portals and the websites of network organisations. Additionally, individual face-to-face interviews have been conducted with representatives from the faculties and special divisions relevant for this field as well as from the Centre for Advanced Food Studies (LMC) in Denmark. Telephone interviews have been conducted when necessary, and the questions for the study have also been sent to researchers as well as institute leaders when personal meetings have not been possible. The numbers of scientists and students in the departments and studies were provided at the time the institutions were contacted; there may, therefore, be discrepancies between our figures and the number of scientists and/or students today. Difficulties in gaining access to institute leaders and researchers have complicated the process of collecting all necessary information. Most often, it has been specific researchers, rather than the institute leaders, that have been contacted in order to get the information needed. However, contacting individual researchers is time-consuming and has, under some circumstances, resulted in insufficient information. This has resulted in more information being collected from websites than from personal interviews, in which explicit figures on students and researchers could be obtained; thus, this report's presentation of the food sector in the region is largely qualitative rather than quantitative.

STAKEHOLDER WORKSHOP

A workshop with stakeholders from the Øresund Region, held in October 2009, helped us to organise and re-think concepts within and relevant for food and food science at universities. The workshop resulted in a map of themes and subjects, which has been useful in understanding the wide range of topics included in this investigation of the whole food value chain. The structure and content of this report has been formed by the outcomes of the workshop.

INVESTIGATIVE QUESTIONS

Questions asked in this investigation, spanning a wide range of topics, were intended to provide a clearer picture of the presence and interactions of the food industry and food studies, as well as ongoing research, in the Øresund Region. There have been some empirical challenges connected to this; as we have worked with a wide definition of the concept of food in relation to research and education, we must make judgment calls in categorising relevant parties for the investigation. For example, many researchers may work in a food-related project parallel with other research projects in other fields, creating a conflict of categorisation. However, for this investigation, if researchers considered themselves to be food scientists, their work was included.

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4 Numbers and projects presented may have changed since the collection of data.

The following points were discussed during interviews or sent via e-mail:

- Number of researchers within the food area. It was advantageous if the interviewees could delineate a division between different levels and professions.
- Number of active PhD students within the food area.
- Number of PhD students that have defended their doctoral dissertations within the field of food since 2005. Information about the number of licentiate and doctoral dissertations completed since 2005 also given.
- Number of registered students as of October 2009. (divided by levels)
    - ¤ Number of students that have graduated since 2005.
- Numbers and descriptions of ongoing research projects in 2009.
    - ¤ Duration of these projects.
    - ¤ Projects in co-operation with other universities, public authorities and private enterprises.
    - ¤ Projects in co-operation with partners from the other side of Øresund.
- Numbers and descriptions of ongoing PhD projects in 2009.
- Number of EU-projects.
- Financing of projects: Amount of external financing. Primary financial actors.
- Financing of PhD students/projects.
- Number of publications within the field of food since 2005. (Includes scientific articles, reports, books and chapters or parts in books.) Note: PhD dissertations are presented separately. Conference papers and manuscripts not yet published are not included.
- Number of patents as of October 2009.

As the present report was being written while the Danish Agency for Science, Technology and Innovation began work on mapping Danish food research; we recommend reading both reports for a better understanding of the state of food research and education in Denmark.

STRUCTURE OF THIS REPORT

Apart from the introduction and the chapter on materials and methods, this report consists of nine chapters, focusing on different areas of food along the whole food value chain. In each chapter, teaching activities and ongoing research projects are discussed, and quantitative data is presented when possible.

Chapter 3 focuses on food and agriculture, discussing food-related programmes and research activities connected to primary production. Chapter 4 deals with food and technology, discussing research areas within food technology, biotechnology, hygiene and food safety. Chapter 5 continues with a presentation of food, nutrition and health from medical and biomedical perspectives. Chapter 6 focuses on food logistics, packaging and design, while Chapter 7 deals with food management, economics, innovation and the food service sector. Chapter 8 presents research and teaching activities with a special focus on the social and cultural dimensions of food, which moves us from food to meals, the context of food and consumers' perceptions of what they eat. Chapter 9, What about gastronomy? tries to capture the multidisciplinarity of food science from production to consumer, while considering aesthetics and communication of food and meals. The final chapters, Chapter 10 and 11, highlight food networks, research cooperation and innovation-supportive organisations that

act on a multidisciplinary level in the Øresund Region, most of them trying to bridge the gap between food science and the food market, as well as between academia and private enterprise.

3. FOOD – AGRICULTURAL PERSPECTIVES AND ENVIRONMENTAL ASPECTS

This chapter addresses the first part of the food chain, which includes not only primary production, agricultural science, research on crops, plants, fruits and vegetables, but also aquatic science and resources on water resources. The chapter also presents the last part of the food chain, that is, food waste management and environmental issues related to food consumption.

In the Øresund Region, this type of research and education is primarily concentrated at the Swedish University of Agriculture Science (SLU) in Alnarp and Balsgård, and at the Faculty of Life Science (KU LIFE) at the University of Copenhagen. Additionally, DTU Aqua, the Department of Aquatic Science at the Technical University of Denmark, focuses on quality of the aquatic environment, freshwater resources and healthy fish products. DTU Food, the National Institute of Food in Denmark, also carries out research on food and environmental issues. Other research institutes and groups outside of these faculties and universities are conducting related research from slightly different points of departure, but with a common interest in gaining better knowledge of food from agricultural, aquatic or environmental perspectives. These approaches will also be presented in this chapter.

FOOD-RELATED EDUCATIONAL PROGRAMMES IN AGRICULTURE AND ENVIRONMENT – SWEDEN

At the Swedish University of Agricultural Sciences in Alnarp, there are three main programmes relating to food. The programmes share a common focus on the primary product (and production) and the quality of the primary product.

The Horticulture programme (300 hp, 4,5 years)[5] focuses on edible and non-edible plants, cultivation, and plant protection and quality. Until 2000, it was a five-year Swedish programme. In 2001, a cooperation with Denmark (the former Royal Veterinary and Agricultural University) was established, resulting in a Swedish-Danish Horticulture programme. The programme, held in English, lasted until 2004; those students who were unable to finish the integrated programme continued studies in their respective countries. In 2005, there was no recruitment to the programme, and since 2006 the programme was once again totally Swedish.

The Garden Engineering programme is a three-year programme, which has also undergone changes during the last decade. Since 2005, the programme has offered students three different specialisations: cultivation, market and design, the first two of which are relevant for

5 The abbreviation "hp" refers to "högskolepoäng," the Swedish credits corresponding to the European ECTS system. One study week (counted as 40 hours including both lectures and homework) gives 1,5 hp and one semester generally counts for 30 hp).

those interested in food science from an agricultural perspective. The programme has many similarities with the Horticulturist programme, but has a much more practical approach. It was previously a two-year programme, but in the fall semester of 2009 was expanded to a three-year programme.

Finally, the two-year Surveying programme (a three-year programme beginning in 2010) has a specialisation in agriculture. Since 2006, 136 students have been examined from the programme.

TABLE 1. THE NUMBER OF STUDENTS EXAMINED FROM FOOD-RELATED PROGRAMMES AT SLU BETWEEN 2005 AND 2009, AND THE TOTAL NUMBER OF STUDENTS PARTICIPATING IN THE PROGRAMMES AS OF 1 OCT 2009

Programme	2005	2006	2007	2008	2009	Number of students registered as of 1 Oct 2009
Garden engineering-Cultivation	-	-	10	16	3	55
Garden engineering-Market	-	-	9	7	6	25
Programmes without specialisation (students admitted before 2005)	19	5	1	-	-	-
Horticulture programme	16	7	10	20	7	40

A master's programme in Agro-ecology, with an expected start date of September 2010, has been planned with partial financing from SIDA[6]. Three programmes, running in parallel, will be located in SLU Alnarp, Ethiopia and Uganda.

Besides the programmes mentioned above, the Swedish University of Agricultural Sciences also offers programmes in subjects such as landscape planning and design. However, these programmes deal, among other things, with landscape management and usage relevant in a broader perspective to food science and cultivation. Kristianstad University also offers a three-year programme in Landscape Management, focusing on these issues, however not with specialised courses in relation to food; a one-year master's programme in Sustainable Water Resources is also offered here.

FOOD-RELATED EDUCATIONAL PROGRAMMES IN AGRICULTURE AND ENVIRONMENT – DENMARK

At the Faculty of Life Science at the University of Copenhagen, education in agriculture and veterinary science in relation to food is well established. The present faculty was established in 2007 as a result of the former Royal Veterinary and Agricultural University becoming a part of University of Copenhagen. In 2008, the former bachelor's in Hortonomy became an integrated part of the Natural Resources bachelor's programme, where students gain knowledge about plants, cells and ecology. The international bachelor's programme in Agricultural Economy focuses on dilemmas within agricultural economics, environmental legislation,

6 SIDA: Swedish International Development Cooperation Agency (Styrelsen för internationellt utvecklingssamarbete)

international economics, politics and development economics, where food supply and production are central themes.

Besides the bachelor's programmes mentioned above, the Faculty of Life Science also offers five candidate programmes (Master of Science, MSc) related to agriculture, resource management and food. The international MSc programme in Agricultural Development focuses on sustainable development in developing countries, on the production of plants, livestock and fibres, food processing and food quality. The MSc programme in Agriculture deals with problems and challenges faced in agricultural production and with developing new and more sustainable production systems related to food, fibre and energy.

On the border between social and natural sciences, the Environmental and Natural Resource Economy programme examines environmental and natural resources, both national and global, as well as integrated economic analysis. Within the programme, students can specialise in food in one of two courses of study: Agriculture and Food Policy or Agricultural Economics. Additionally, the MSc programme in Horticultural Sciences focuses on the biology of plants and their interaction with the environment, technology and the economy. The programme includes courses on sustainable production, plant protection, ecological consequences and ways to increase health-promoting constituents in fruit and vegetables. Finally, in the MSc programme in Agricultural Economics, students are taught to analyse local as well as global problems in international economics and food politics. The programme has two specialisations: International Economy and Development and Agribusiness, and Food Economy.

The Faculty of Life Science also offers, in collaboration with five other European universities, the two-year international MSc-programme Agris Mundos – Sustainable development in agriculture, which focuses on agricultural development and management of natural resources. The programme is offered by a consortium of universities in France, Italy, the Netherlands, Spain and the United Kingdom, and includes studies on, among other things, human nutrition and food systems, and local development and food security.

Table 2 shows the number of students examined 2007-2008 in the above-discussed bachelor's (BSc) and MSc programmes at the Faculty of Life Science at the University of Copenhagen. The University Reform in 2007 in Denmark resulted in a new division of programmes, which explains the lack of adequate numbers for 2005-2006. The last column shows the number of students registered in the programmes as of 1 October 2009.

TABLE 2. NUMBER OF STUDENTS EXAMINED IN 2007-2008 IN DISCUSSED BSC AND MSC PROGRAMMES AT THE FACULTY OF LIFE SCIENCE, UNIVERSITY OF COPENHAGEN

	2007	2008	2009 (registered)
Natural Resources (BSc)	1	33	228
Hortonomy/ Horticulture (BSc)	11	7	41
Agricultural Economy (BSc)	14	16	72
Agricultural Development (MSc)	17	19	131
Agricultural Economy (MSc)	11	14	62
Environmental and Natural Resource Economics (MSc)	-	12	36
Hortonomy/Horticulture (MSc)	10	12	29

The Technical University of Denmark (DTU) recently created a new MSc programme in Aquatic Science and Technology in collaboration with the University of Copenhagen. The programme adopts an interdisciplinary approach in focusing on sustainable utilisation of marine and freshwater ecosystems and new aquatic production systems. The first students started in September 2009 and as of 1 October 2009, eight students were active in the programme.

There is also a number of research programmes geared towards students on a PhD level within this specific field of research. The Research School of Horticultural Sciences (RSHS) is a collaboration between the Faculty of Life Sciences, University of Copenhagen and the Faculty of Agricultural Sciences, University of Aarhus. The Research School for Biotechnology (FOBI) gathers and supports doctoral students with interests in biological systems; FOBI is part of the Danish Biotech Research Academy (DBRA), a network of research schools in Denmark. The Research School for Organic Agriculture and Food Systems (SOAR) is open for PhD students in the fields of ecology, agriculture and food; SOAR also participates in the International Research Centre for Ecological Agriculture (FØJO) at the University of Copenhagen.

FOOD-RELATED RESEARCH IN AGRICULTURE AND ENVIRONMENT – SWEDEN

Research on agriculture as well as on environmental aspects of food, food production and consumption are, in Skåne, mainly conducted at the Swedish University of Agricultural Sciences in Alnarp and Balsgård. However, as was mentioned initially in this chapter, relevant research activities are also conducted at other universities and faculties. For example the Department of Sociology, University of Lund, is involved in a larger project called *"Afrint,"* which consists of a team of scholars researching the drivers of agricultural intensification in sub-Saharan Africa as an example of focusing on food and agriculture in developing countries. The project's aim is to better understand the nature of the African food crisis and means of alleviating it. The Swedish team consists of seven researchers from different departments at University of Lund and Linköping University.

The Swedish team is responsible for comparative analysis between sub-Saharan African agricultural practices as well as for analysis and comparisons between the Asian and African

experiences with food problems. Additionally, nine sub-teams, representing different African countries, contribute to the research. The three-year project, financed by the Swedish Research Council and SIDA will be completed in 2010, and has been externally funded by about SEK 5 million. The project has resulted in approximately eight publications. Furthermore, at the University of Lund Centre for Sustainability Studies (LUCSUS), a PhD project is focusing, in connection with the project, on the production of sugar in Kenya and its social, economic and environmental consequences.

SLU, THE SWEDISH CENTRE FOR FOOD AND AGRICULTURE

The Faculty of Landscape Planning, Horticulture and Agricultural Science at the Swedish University of Agricultural Sciences (SLU) is divided into eight different departments (almost all of them including research with relevance for the food sector[7]) and about 18 different research groups and minor divisions. They cover a range from plant breeding, plant protection and product quality to production systems, land use management and economical and consumer aspects related to agriculture and agricultural products.

Many projects at SLU are financed by the 10-year programme *"Tillväxt Trädgård"* (growth garden), which is a cooperation between LRF-GRO[8] and SLU Alnarp. The programme was started in 2008 with the aim of strengthening cooperation between industry and the university and to act as a partner within projects. The initiated projects are financed either by the Swedish Board of Agriculture (SJV) or by the growth fund of "Tillväxt Trädgård," from which researchers can apply for project support. There are three sub-projects (large projects) primarily financed by SJV. They will contribute SEK 10,5 million over three years. One of these projects with the Swedish title *"Ökad kunskap kring export och marknad"* (Increased knowledge of exports and markets), deals with marketing development, focusing on innovation, new berries and vegetables. On the other hand, "Tillväxt Trädgård" also has a growth fund for smaller projects where SLU Alnarp and LRF-GRO each are able to finance SEK 3 million over three years.

In the following pages, we will present research relevant for food at SLU Alnarp and Balsgård, demonstrating the wide range of research areas and projects conducted within this major field. Some of the numbers discussed will also be summarised in tabular form at the end of the chapter.

PLANT BREEDING AND BIOTECHNOLOGY

At the Department of Plant Breeding and Biotechnology research focuses on plant breeding and preservation of plant genetic resources and production of varieties on fruits, berries and potatoes. Plant genetic research is conducted on garden plants as well as agricultural plants to investigate extent, genetic variation and specific traits. The area has a strong connection to biotechnology and applied plant breeding research. In the department, located in Alnarp as well as in Balsgård, Skåne, research is internally divided into four research groups. Biotechnology Agriculture focuses mostly on seed oils, including oils from the annual oil crops,

7 The main centre for food studies as well as the Department of Food Science is, however, located at SLU in Uppsala.

8 GRO stands for "Gröna näringens riksorganisation," or National Organisation for Green Industry. GRO is part of the Federation of Swedish Farmers (LRF).

whereas Biotechnology Horticulture aims to improve plant properties and efficient production of plant species using biotechnology. Different traits like disease resistance, weed competition, nutrient uptake, etc. are studied in crops such as wheat, barley and potatoes. Meanwhile, the research group of Plant Breeding Agriculture conducts research on how crop production can deliver optimal yield of high quality products with reduced environmental effects as well as reduced fuel inputs. Finally, the researchers at Balsgård constitute the group Plant Breeding Horticulture, where research is conducted within the field of genetics and plant breeding, mainly focusing on fruits and berries.

Balsgård started as an institute for fruit breeding in the early 1940s, but it was first in 1970 that it became part of the former *Lantbrukshögskolan*, or agricultural school (now SLU). Today, research projects are conducted on established crops like apples and black currants as well as on novel crops. Applied research is undertaken concerning, for example, durable production methods for fruit and berry crops, harvesting and post-harvest treatments and storage. As part of their activities, researchers also preserve and utilise genetic resources at Balsgård.

There are many ongoing research projects at the department in relation to the field of foods[9]. In 2009, there were between 30 and 40 ongoing projects of various sizes at Balsgård. Among the five largest projects, three were financed by Formas (a total of SEK 6 million), one by VR/SIDA (SEK 595 000) and one with grants from EU (SEK 2 million). The main part of the activities at Balsgård is funded by external sources and Balsgård receives between SEK 8 and 10 million annually in external grants (2008: SEK 8,2 million). The largest part comes from research councils, including Vinnova, and research foundations, including SSF, Mistra, KK, KAW, and SLF (about 50%). The second largest portion comes from Swedish public authorities (about 25%), while their remaining funds are granted by the EU (however, only a minor part) and from industry.

Most of the projects have cooperation partners at other departments at SLU as well as other universities. About 75% of the projects are operated in collaboration with private partners, with the purpose of pursuing research with direct relevance for the industry as well as for consumers. This is reflected in new governmental funding for plant breeding, starting its first call for research proposals at the end of 2009. A total amount of SEK 8 million is intended for this specific purpose, with SLU, Formas, SLF and the Swedish Board of Agriculture (SJV) each contributing one fourth. The purpose is to strengthen the applied research activity, suggesting that research applications must be based on cooperation with private partners.

NUMBER OF RESEARCHERS AND PHD STUDENTS[10]

At Plant Breeding Horticulture at Balsgård, there are 8 researchers and 7 technicians (e.g., laboratory engineers) working permanently with research related to food as well as 2 full-time PhD students. Both students are funded 100% by scholarships from the Nordic Council

9 Most research with direct relevance to this field is conducted at SLU Balsgård. However, it has not been possible to get specific information regarding relevant research activity among the other research groups at this department.

10 The presentation of number of researchers, publications and patents lacks information from three out of the four research groups. Therefore, the presentation will only include information from the group Plant Breeding Horticulture at Balsgård.

of Ministers and SIDA (Swedish International Development Cooperation Agency) and from the students' home country of Pakistan. One PhD student is working part-time as a technician and part-time with the dissertation.

PUBLICATIONS AND PATENTS

There have been 143 publications by the researchers working at Balsgård between 2005 and 2009, of which 76 are international articles, 63 Swedish articles and 4 books. Three doctoral dissertations have been published within the field during this period of time. About 90% of the total amount of publications at Balsgård concerns edible crops, mostly fruit, berries and potatoes.

There are between 20 and 25 active patents at Balsgård. However, the exact number varies depending on whether the patent rights are renewed or not. A patent may include breeding rights on certain plants, but it could also patent specific products or allow farmers to use the specific crops for a certain period of time.

PLANT PROTECTION BIOLOGY

The Department of Plant Protection Biology is divided into four research groups: Chemical Ecology, Integrated Plant Protection, Resistance Biology and Nematology. Chemical Ecology is the largest research group with six ongoing projects, mainly in a newly-established cooperation with Malmö University Hospital (UMAS) on polyphenols in wine but also in fruits and potatoes. There is also one project focusing on apple production and problems with damages in the crop. According to SLU's 2008 self-evaluation, the five major, ongoing grants from research funding agencies in Sweden and internationally make up a total amount of almost SEK 100 Million (98,3). However, these are not specified in food-related and non-food related research.

Furthermore, there are six ongoing projects within the research group Integrated Plant Protection, focusing on garden plants and ecological production of cabbage, for example. The projects also deal with conservation of biological control and with diseases in different kinds of crops, with the aim of reducing the amount of pesticides used while maintaining or increasing production.

There are two projects within the group of Resistance Biology, and four projects within Nematology, focusing on resistance from different perspectives (e.g., in coffee and potatoes) and on allergens in apples. Some projects are operated in cooperation with the University of Lund, but also with universities in Nicaragua, Colombia and Vietnam through PhD-student projects. All PhD students are externally financed by Formas, SLF or SIDA. The other research projects are mainly funded by one of the three organisations just mentioned, Partnerskap Alnarp (Partnership Alnarp)[11] or the Swedish Board of Agriculture.

The leader of the department estimated that about 30 to 50% of the external funding was aimed at food-related research.

11 Partnerskap Alnarp is a cooperation organisation between SLU Alnarp, industry, public authorities and trade organisations in the south of Sweden (also presented in Chapter 9).

NUMBER OF RESEARCHERS AND PHD STUDENTS

In November 2009, there were 10 researchers and 8 PhD students at the Department of Plant Protection Biology involved in research related to food. Since 2005, three PhD students have completed their doctoral dissertations within a subject broadly related to food.

PUBLICATIONS AND PATENTS

Based on publication lists from the most cited researchers at the department within the field of food, approximately 140 publications were published between 2005 and 2009, including scientific articles as well as articles in popular science magazines, reports and book chapters[12]. There have been three patents reported[13].

HORTICULTURE

At the Department of Horticulture there are three research groups focusing on biological research within horticultural production and product quality. The department focuses on cultivation as well as production and quality among fruits and berries, mushrooms and vegetables (e.g., following the chain from production to cultivation and storage). Within the research group of Horticultural Product Quality and Aftercrop there were 10 projects ongoing in October 2009, including PhD projects (two of them are conducted by a researcher within the group, but the base of the projects are within another section). All projects focus on quality, preservation of quality and bioactive substances. The projects include carrots and organic carrots, green vegetables, raspberry and blackberry, basil and other herbs. Two of the projects are funded by "Tillväxt Trädgård."

The research group Horticultural Microbiology had 13 ongoing projects related to food at the end of 2009. Five of these were conducted in collaboration with other universities and eight together with industrial partners and/or with public authorities. The projects were financed 80% by public funds and 20 % by private funds. The PhD students were externally financed by research funding, foundations and by industry.

The last research group deals with greenhouse as well as outdoor production and cultivation. One project, financed by Partnerskap Alnarp, for example, deals with decreased leakage of nutrients from cultivation of outdoor vegetables and a decreased use of phosphorus fertilization in cultivation of potatoes[14].

NUMBER OF RESEARCHERS

The research group Horticultural Product Quality and Aftercrop consists of 3 researchers (1 professor, 1 post-doc and 1 student that recently has defended his dissertation) and 3 PhD students. Three PhD students within the group have completed their doctoral dissertations since 2005. Horticultural Microbiology is a team of 5 researchers (4 senior researchers and 1 post-doc) and 6 PhD students. Since 2005, two students have completed their licentiate dissertation (and two are expected to defend their doctoral dissertations in 2010).

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12 Integrated Plant Protection: 23 published articles (including proceedings: 4, 19 reports and popular science magazines). Chemical Ecology: 71 (including published articles, reports and popular science magazines). Resistance Biology: About 25 publications

13 The presentation lacks information from two of the three research groups at the Department of Plant Protection Biology.

14 There is a lack of information from the last research group regarding ongoing projects, number of researchers and PhD students, and publications.

PUBLICATIONS

Between 2005 and 2009, Horticultural Product Quality and Aftercrop had 17 peer-reviewed articles (plus 3 submitted in 2009) and 9 proceedings and international publications in reports. Horticultural Microbiology had 58 publications (including popular science articles) during this period.

AGRICULTURE – FARMING SYSTEMS, TECHNOLOGY AND PRODUCT QUALITY

At the Department of Agriculture – Farming Systems, Technology and Product Quality, researchers study, among other things, corn, grain and cereals and how the production system, including technology, interacts with and influences the quality of the product as well as the environment. The department is divided in four parts focusing on different aspects of agriculture: cultivation system, technology, product quality and statistics. There are 13 ongoing projects reported within the department, most of them conducted in collaboration with private partners and/or with public authorities (no EU-projects)[15]. Three of the projects concern wheat quality and two of them are conducted together with the companies Svalöf Weibull and Lantmännen Cerealia. One project, concerning minerals in wheat and ecological production, is operated together with Danish actors. These projects are primarily funded by SLF and Partnerskap Alnarp. Several research projects also concern nitrogen in wheat. One project on grain and plant-louse resistance is being conducted together with other universities as well as with private actors and public authorities. The projects are financed by MISTRA, the Foundation for Strategic Environmental Research[16]. Other projects deal with weed control in organic grown vegetables as well as in orchards (organic fruit production) and in potatoes. Other projects concern the technology of cultivation and aim to improve conditions for production in Sweden. Major financial partners are SJV and Partnerskap Alnarp.

NUMBER OF RESEARCHERS

They are eight researchers active in food-related research. The researchers often have many ongoing projects, where some are related to food while others' foci are within other fields. There are six active PhD students who are externally as well as internally funded. However, most of the students receive a larger part from external funding, where Formas and SIDA are major partners.

PUBLICATIONS AND PATENTS

There have been 53 publications reported with relevance for food at the department[17]. Additionally, 17 dissertations related to food have been completed at the faculty between 2005 and 2009, according to one of the researchers at the department. There has been one patent reported concerning transgenic rapeseed.

WORK SCIENCE, BUSINESS ECONOMY AND ENVIRONMENTAL PSYCHOLOGY

The Department of Work Science, Business Economy and Environmental Psychology is divided in three minor divisions, where work science and business economy are areas in which food-related research and projects are carried out. A previous project within work science

15 There are 13 projects reported at the department. However, three researchers have not reported information about their research activity.

16 For more information, see www.plantcommistra.com.

17 The number given does not include all publications. Publication lists from three researchers are missing.

dealt with lifelong learning and the food chain, and there is another ongoing PhD project about knowledge in the food chain and managers' ways of learning in smaller food companies. There is also ongoing research on health and food security, and tourism development in the countryside in relation to primary production and agriculture. Furthermore, there are plans for engaging a new PhD student in the area of food, garden production and food security.

Within the division of Business Economy, there are mostly minor ongoing projects dealing with consumer aspects and market issues related to fruits, vegetables and potatoes. Three projects, financed by the programme "Tillväxt Trädgård," focus on strawberries, potatoes, tomatoes and cucumbers. Another project concentrates on apples from an environmental perspective. Two PhD students are involved in the projects focusing on potatoes and marketing to the senses. The PhD students are financed by the faculty through the research school called Sensys, which focuses on sensation and interaction of the senses from different perspectives. One larger project, also funded by Tillväxt Trädgård," contributes to research in marketing development. The project is financed by the Swedish Board of Agriculture at SEK 100 000 per year for three years, wherein about SEK 50 000 go primarily to marketing development of fruits and vegetables in cooperation with Growth of Knowledge (GFK).

There is also a project financed by Formas with SEK 2,2 million, with the Swedish title *"Konsumtionsvärde och engagemang i ekologiska livsmedel"*(Consumption value and commitment to organic food), with focus on fruits and vegetables. One PhD student is partly financed by this specific project. One assistant master is working within a project about growth in large-scale farming in Skåne (as part of a planned licentiate dissertation) and another assistant master is working with systems for better governance in greenhouses and with cost estimations in ecological agriculture. However, these are minor projects financed by the Swedish Board of Agriculture.

NUMBER OF RESEARCHERS

There are 12 people in total (+ 1 guest professor) at the department with research activity relevant for the food sector (2 professors, 2 senior researchers, 3 PhD students, 4 assistant masters, 1 research assistant and 1 guest professor).

NUMBER OF PUBLICATIONS

There have been 13 publications reported with relevance to food from 2005 to 2009.

ADDITIONAL DEPARTMENTS

The Department of Rural Buildings and Animal Husbandry as well as the Departments of Landscape Planning and Landscape Architecture deal, to some extent, with research relevant to food. For example, 3 researchers at the Department of Rural Buildings and Animal Husbandry are involved in studying milk production from different perspectives and during the last 5 years there have been initiated approximately 20 projects. These have been financed by the Swedish Agricultural Industry's Organisation for Funding of Research and Development (SLF), Formas, Swedish Board of Agriculture (2-3 projects), and Partnerskap Alnarp (10-15 projects). The projects are run in cooperation with other institutes at SLU in Sweden as well as SIK in Gothenburg, and with private partners such as the Swedish Board of Agriculture, Skånesemin and Skånemejerier. One PhD project is currently being conducted in cooperation with Aarhus University in Denmark. The projects have resulted in a number of

publications; in 2009, there were about 20 publications relating to food in various journals and magazines. At the Departments of Landscape Planning and Landscape Architecture, researchers deal with land use issues, also in relation to use of land for agriculture and food production. The programme of Landscape Management at the University of Kristianstad is another example, where these issues are discussed and elaborated on.

TABLE 3. NUMBER OF RESEARCHERS, PHD STUDENTS, RESEARCH PROJECTS, PUBLICATIONS AND PATENTS FOR DEPARTMENTS RELATED TO FOOD STUDIES AT SLU

Swedish University of Agricultural Sciences (in Alnarp and Balsgård)	Number of employees/ researchers (alt. research groups)	Number of PhD students	Number of research projects	Number of publications (and patents), 2005-2009
Dept of Plant Breeding and Biotechnology	4 research groups	2 PhD + 1 (only at Balsgård)	30-40 (only at Balsgård)	143 (only at Balsgård)
Dept of Plant Protection Biology	10 researchers	8 PhD students	18	Approx 140
Dept of Horticulture [1]	8 researchers	9 PhD students	23	-
Dept of Agriculture – Farming systems, Technology and Product quality [2]	8 researchers	6 PhD students	13	53
Dept of Work Science, Business Economy and Environmental Psychology	9 researcher (+ 1 guest professor)	3 PhD students	Approx 10	13

1 Results from one of the three research groups are missing.

2 Three researchers with relevance for the area of food science failed to report information about their projects.

FOOD-RELATED RESEARCH IN AGRICULTURE AND ENVIRONMENT – DENMARK

FOOD AND AGRICULTURAL SCIENCES

The Faculty of Life Sciences at the University of Copenhagen (2010) introduces itself on the website as follows:

> At the Faculty of Life Sciences, the traditional food, agriculture and veterinary science disciplines go hand in hand with new fields such as nanotechnology, plant biotechnology, reproduction technology, biomedicine, chemometry, interdisciplinary service subjects such as bioinformatics, and not least the ethically oriented areas such as bioethics and research animal welfare.

The core research areas at the Faculty of Life Science at the University of Copenhagen include a focus on agricultural science from different perspectives. The area of plants, cultivation and natural resources is described as one of seven special competencies at the faculty. Some of these core research areas focus on food and agriculture from different angles:

- *Plants for the future – Functional genomics and molecular breeding for improved productivity, stress, tolerance and plant-environment interactions.*
- *Improved biopolymers and bioactive constituents from plants*, where one main target is to improve rheological properties in food and low digestibility to prevent obesity.

- *Soil, water and land use,* focusing on how to use land for different purposes including food production (e.g., 75% of the world's consumption of fresh water is used for food production, indicating an extreme pressure on land as well as on water resources. Research claims that future water supply can only be achieved if, among other things, new crops and cultivation techniques are developed).
- *Sustainable approach to agriculture, food and people in developing countries,* which is characterized by a multi-disciplinary approach, ranging from primary production to issues of consumption and consumer behaviour.
- *Sustainable primary production and bioenergy,* with focus on the impact of climate change on agriculture, food security and food quality around the globe, implying the need for sustainable food production.
- *Environment and natural resources: Economics and management,* which primarily addresses the social use and management of environmental services and natural resources.
- *Bioethics – Interdisciplinary research on ethical and societal aspects of biological science,* where one main field of study is on food safety and the difference in perceptions of risk between actors.
- *Bioimaging – Plants, animals and microorganisms,* focusing on multi-cellular organisms and how organisms adapt to shifts in the environment. Topics are, for instance, biological control of crop plant pathogens, food microbiology of non-pathogenic bacteria, the relation between microstructure and functionality in foods, and working with design of improved hydrocolloidal gels for low-fat food products.
- *Nanobioscience and environmental nanoscience.* One research theme aims for example, to design biopolymers with new functional characteristics and to enhance the synthesis of natural products with improved properties (e.g., health-promoting food components and flavours).

There are three main departments at the Faculty of Life Science focusing on agricultural science in either applied or basic science research projects. The Department of Agriculture and Ecology has a special focus on the effects of climate and environmental changes and the interaction with ecology and eco-systems. Research activity at the department is organized in six sections: Crop Science, Botany, Genetic and Micro Biology, Environment, Resources and Technology, Plant and Soil Science and Zoology. The department also manages a horticultural garden and has greenhouse facilities. They also maintain an apple museum, which is a part of the Nordic Gene Bank. The section Crop Science also coordinates the consortium, Team Horticulture.

The Department of Plant Biology and Biotechnology primarily conducts basic research in molecular biology and focuses, among other things, on the development of healthier food and development of plants with new assignments. There are three main research areas, however multidisciplinary, at the Department of Plant Biology and Biotechnology: metabolism in plants, transport processes and plants' interaction with the surrounding environment. Examples of themes within these main areas are food, quality and fungi, healthier cassava, healthy seed and resistant starch.

At the Department of Basic Sciences and Environment researchers carry out basic science with direct relevance to agricultural science and they take part in numerous projects, also within the field of dairy and food chemistry.

Research activity within the field is also to be found at other institutes at the Danish side of Øresund. The Department of Genetics and Biotechnology, located on Zealand but organized as a department of the Faculty of Agricultural Sciences, Aarhus University, deals, for example, with gene modification of crops. Furthermore, and from a slightly different perspective, there are also multi-disciplinary research projects within the field of quality production of baby leaves conducted by the research group Health, Environment, Everyday Life and Food Production at Roskilde University. The PhD project *"Frøkvalitet i et kædeperspektiv"* (Seed quality in a chain perspective), with focus on quality production of baby leaves in Denmark as well as the perception of quality by the consumer, has been involved in studying crop management and seed production of grass and vegetables. Focus was on, among other areas, optimizing cultivation techniques, improving product quality and enhancing crop competitiveness against weeds (the project ended in 2009).

FOOD AND AQUATIC SCIENCES

In discussing the food chain from soil to table/consumer and back to soil again, the ocean and our water resources are often forgotten. DTU Aqua – the Danish National Institute of Aquatic Resources – is one of 24 departments at the Technological University of Denmark (former known as the Danish Institute for Fisheries Research), which primarily conducts research and undertakes education in the area of sustainable aquatic environment, focusing on issues concerning freshwater resources as well as ecosystem structure and function. The Danish Ministry of Food, Agriculture and Fisheries finances approximately 70% of the institute. The institute studies the relationship between aquatic environment and production of fish and shellfish and deals with processing and improving fish products into healthy foods. The research is divided into four main areas: Commercial Fisheries, Aquaculture, Fish Products and Recreational Fisheries. The following research groups have been identified by LMC in Denmark as relevant within the sciences of food:

- Aquatic Microbiology and Seafood Hygiene
- Aquatic Lipids and Oxidation
- Aquatic Protein and Biochemistry
- Aquatic Process and Product Technology

DTU Environment (the Department of Environmental Engineering), one of the largest university departments specialising in environmental engineering in Europe, also carries out research in the field of water resource engineering from national as well as international perspectives. The research aims at better understanding the problems related to environment and resource issues and to develop tools for a sustainable society.

Water and the quality of water also constitute a strategic research initiative at the Faculty of Life Science at the University of Copenhagen, under the title "ViVa" (Viden om Vand, or knowledge on water) with focus on water in nature as well as in food production. Modelling is an integrated part in all areas. Research projects are, for example, focusing on environment and agricultural microbiology, safe and high quality food production using low quality water, and sustainable water use in securing food production in dry areas of the Mediterranean region.

4. FOOD – TECHNOLOGY, BIOTECHNOLOGY, FOOD QUALITY AND SAFETY ISSUES

This chapter focuses on the areas of food science primarily related to technology, production chemistry, food quality and food safety. Research in these areas mainly takes place at the Technological University of Denmark (DTU), the University of Copenhagen (KU) and at the Faculty of Engineering (LTH) at the University of Lund. Whereas DTU is the primary university in Denmark within the area of technology and natural sciences, the Faculty of Engineering at the University of Lund is one of the leading engineering faculties in Europe.

EDUCATIONAL PROGRAMMES IN THE SCIENCE OF FOOD – SWEDEN

The Faculty of Engineering, University of Lund, offers a five-year programme in Biotechnology, which leads to a MSc in Engineering. The programme in biotechnology covers a wide range of areas, including pharmaceuticals and food, development of new techniques, chemical engineering and microbiology. The programme is divided into a three-year period of basic courses and a two-year period of advanced courses. During the final two years, the students choose one of four areas of specialization, where food is included. Several food-related courses are offered, for example in food science, probiotics, dairy technology, physiology, human nutrition and functional foods.

LTH University Campus in Helsingborg (LU) also offers a two-year programme in Food Technology (120 hp), which leads to a university diploma in Applied Technology – Food Science. This vocational programme is offered in cooperation with LTH and the Department of Food Technology in Lund. The programme began in 1975, when it was functioned as vocational training with specialisation towards the food industry. However, since 2006, students completing the course obtain a university diploma. The programme has been developed in cooperation with representatives from industry; students regularly interact with companies in the region through projects, seminars and lectures. The programme has six teachers on-site (two of which are assistant masters), all of them connected to the Department of Food Technology in Lund, however, based at the university campus. Interesting to mention is also the separate course with the Swedish title Drycker, Vetenskap och Teknik (Drinks, science and technique), in which 18 students were registered during the spring semester of 2009.

TABLE 4. NUMBER OF FULL-TIME STUDENTS REGISTERED IN THE MSC PROGRAMME IN ENGINEERING – BIOTECHNOLOGY IN LUND AND IN FOOD TECHNOLOGY AT LTH HELSINGBORG FROM 2005 TO 2008.

	LTH, Lund	LTH, Helsingborg	Total
2005	76	-	76
2006	86	67	153
2007	96	50	146
2008	76	57	133

During the fall semester of 2009, approximately 15 students were attending the MSc programme in Engineering in Biotechnology with specialisation in food (estimation based on the number of registered students in specific courses[18]). Since 2005, about 67 students have chosen the food specialization for an MSc in Biotechnology. In the fall semester of 2009, a total number of 290 students were registered in the MSc programme in Biotechnology at LTH and 47 students studied for a diploma in Applied Technology – Food Science in Helsingborg (26 first-year students and 21 second-year students).

EDUCATIONAL PROGRAMMES IN THE SCIENCE OF FOOD – DENMARK

There are many courses and programmes in the field of food technology that have an interdisciplinary approach, integrating not only technological and biotechnological aspects, but also chemistry, medicine and so forth. The Technical University of Denmark (DTU), for example, offers a bachelor's programme (BSc) in Human Life Science Engineering, which is an illustration of this multidisciplinary approach. This is a new programme in the interface between technology, biology, chemistry and medicine, which aims at providing knowledge about how to prevent diseases and increase health. The programme had 106 students registered as of 1 October 2009. DTU also offers an MSc programme in food technology, which also has a multi-disciplinary approach, including subjects such as microbiology, biochemistry and engineering. Completion grants the title MSc, Engineering (Food Technology). There were eight active students in the programme in October 2009[19].

Studying to become a food engineer *(levnedsmiddelsingeniør)* at DTU is part of a 3,5-year BS programme. Since 2005, about 40 students have graduated from this programme. The education to become a food analyst *(fødevareanalytiker)*, a newly started 3,5-year programme offered by DTU in cooperation with KU LIFE, addresses the need for better knowledge in securing quality as well as control of food. The students are gaining insights in chemistry, microbiology, biochemistry and hygiene, to mention only a few of the subjects.

Many programmes, especially at the master's level, are operated in cooperation between universities. Food Science and Technology is one example of a master's programme (leading to the title MSc in Food Science and Technology), administered and operated by DTU and KU LIFE in cooperation, with courses held at both universities. The programme focuses on production of food, nutrition and health, including knowledge in biotechnology, microbiology, biochemistry, nutrigenomics and bioinformatics. 107 students were registered at the programme as of 1 October 2009. 43 students graduated from the programme in 2007 and 29 students in 2008. On a bachelor's level, the University of Copenhagen also offers a three-year programme in Food Science as an introduction to study food science. There were 244 students registered in the programme as of 1 October 2009.

Besides the programmes and courses that have a special and particular focus on food, many educational programmes include either minor elements of food in their courses, or have

18 The students earn a general degree in Biotechnology; specialisations chosen are not registered. Therefore, it has not been possible to determine the exact number of students that have graduated within a specific specialisation.

19 The programme is rather new. The first students graduated in 2008.

major impact on our knowledge of food without actually touching on food studies in a specific course. Both DTU and the University of Copenhagen offer bachelor's as well as master's programmes in Biotechnology, which have a multidisciplinary approach encompassing, beyond biology and biotechnology, biochemistry, genetics, bioinformatics and engineering science. "For centuries, biotechnology has been used in the manufacture of beer, wine, cheese and bread," is stated on DTU's (2011) website, highlighting the biotechnology programme's relevance in the area of food. Food Biotechnology plays an important role in the food industry as well as at the end of the food chain in handling the waste from, for example, agricultural production. At DTU, there were 172 bachelor's students and 153 master's students registered as of 1 October 2009. Additionally, there were 17 students slated to graduate with an MSc in Biotechnology in 2009. Furthermore, at the University of Copenhagen, there were 1,102 students in total registered in the bachelor's programme in Biology/Biotechnology and 383 students in the master's programme in the fall semester of 2009[20].

Systems Biology is another field of relevance for the area of food in its focus on interactions between biological systems. The knowledge gained at the MSc programme in Systems Biology at the University of Copenhagen may play a part in developing more efficient cell factories for the production of food ingredients. Additionally, nanotechnology has gained enormous influence in many areas, including food. This is demonstrated in various research projects, and is relevant for graduates studying food in relation to nanotechnology.

INTERNATIONAL MASTER'S PROGRAMMES IN THE AREA OF FOOD

Universities on both sides of Øresund offer international master's programmes for students from around the world. The University of Lund (LTH) offers, for example, a two-year International Master's degree in Food Technology and Nutrition. The programme started in 2007 and had, during the fall semester 2009, 37 students registered from different countries. The former 1,5-year master's programme Bio- and Food Technology started in 2003, but was divided into two programmes in 2007: Biotechnology (mentioned above), and Food Technology and Nutrition.

TABLE 5. NUMBER OF STUDENTS THAT HAVE COMPLETED INTERNATIONAL MASTER'S DEGREES IN BIO- AND FOOD TECHNOLOGY, AND SINCE 2007, IN FOOD TECHNOLOGY AT LTH.

Year	Number of students
2003	24
2004	23
2005	22
2006	15
2007	4

Teachers and researchers at the Department of Food Technology, Engineering and Nutrition at the University of Lund are also involved in two other international master's programmes, which are not located in Lund. The European Master's degree in Food Studies is offered in

20 Between 2005 and 2007, the programme was only named Biology. In 2008, the programme was dubbed Biology-Biotechnology, covering a wider range of subjects at the University of Copenhagen than at DTU.

cooperation with the University of Wageningen, the Netherlands, as well as with universities in Paris and Cork. The International Master's in Dairy Science and Technology is offered at University of Copenhagen (KU LIFE), where researchers from LTH are also involved as guest speakers.

The University of Copenhagen has also been part of developing the programme called Lactitech, which was planned to start in 2010. The programme, focusing, among other things, on dairy technology, dairy chemistry, dairy microbiology and dairy processing was developed in collaboration between the Faculty of Life Science at the University of Copenhagen and Wageningen University, the Netherlands. The programme leads to an MSc in either Food Technology or Food Science and Technology.

The international MSc programme in Safety in the Food Chain (SIFC) is offered by a network of five European universities and the University of Ljubljana and coordinated by BOKU in Wien. The programme focuses on issues related to food safety and food safety management, both from national and international perspectives. Approximately 15 students have been following the programme since 2007, and 5 of these students have been studying at KU LIFE for one semester. However, only few students have graduated so far[21].

Additionally, the two-year Erasmus Mundus programme Food of Life is offered by KU LIFE in collaboration with the Swedish University of Agricultural Science, Universitat Autónoma de Barcelona, Spain and the University of Helsinki, Finland. This is an international cross-disciplinary MSc programme in the science of animal-derived food, combining food science and technology. The first course started in September 2010[22].

RESEARCH IN THE SCIENCE OF FOOD – SWEDEN

FOOD TECHNOLOGY, ENGINEERING AND NUTRITION

The research activity presented here is conducted primarily at the Department of Food Technology, Engineering and Nutrition (LTH) in Lund and Helsingborg, as well as within the Department of Chemistry (LTH). The Department of Food Technology, Engineering and Nutrition conducts research on the chemical and physical design of health-promoting food, including chemical changes in the food and the effects of food on our health.

The Department of Food Technology, Engineering and Nutrition has about 60 employees divided in two divisions: Food Technology and Applied Nutrition and Food Chemistry.

The division of Food Technology carries out research in processes used in food production (e.g. heating, cooling, drying), and their optimization to ensure the best food quality. Furthermore, research deals with the relation between food quality and its structure, as well as with pharmaceutical technology. Since 2005, there have been 56 different projects within the division, and in 2009, 21 of these were still ongoing. The projects last from two months to four years; the latter often concerns PhD projects. The majority of the projects are con-

21 This is according to a coordinator at University of Copenhagen. However, the head coordinator is located in Wien, Austria, and there has been no answer from the latter individual regarding the exact number of students that have graduated.

22 Already at the end of 2009, 163 people had applied for the programme, many from non-EU countries.

ducted in cooperation with industrial partners, and over 70% of the projects are organized together with external industrial partners. The division cooperates with the Faculty of Life Science, University of Copenhagen, primarily within Diary Technology, and there are plans for engaging a new PhD student within this research field. Researchers from the division are also teaching in other areas such as Meat Technology at the University of Copenhagen.

The division has about 35 employees, 9 of whom are professors and about 20 of whom are PhD students. The rest of the employees are senior researchers and administrative personnel.

The division of Applied Nutrition and Food Chemistry deals with the composition and properties of food in relation to health and health effects. Special focus is directed towards design of food and food processes, in order to try to reduce risk of disease. Among the specialised areas are: prebiotic and/or probiotic food, partly in cooperation with the Functional Food Science Centre and the Antidiabetic Food Centre (to be presented in Chapter 5), hygiene, glycemic index and glucose tolerance.

Research activity in the division is divided into three sections: Industrial Nutrition, Food Hygiene and Food Chemistry. There are 27 researchers connected to the division, including 3 guest researchers from Brazil, Ecuador and India, 10 PhD students, and 2 projects assistants. However, new PhD students will soon begin their research educations, resulting in there being a total of 13 PhD students. There were five active research groups within the division and between 25 and 30 ongoing research projects in the fall semester of 2009. Two-thirds of these projects were being conducted in relation to industrial partners, and all of them were being carried out in cooperation with other departments or faculties at the University of Lund. About five of the projects were being conducted in cooperation with researchers outside the University of Lund. Two of the research groups had projects financed by Øresund Food (formerly Øresund Food Network).

Research projects at the department are, to a major extent, externally financed by industry via industrial foundations and through co-financing in relation to Vinnova projects. Strong financial partners in the projects are: SLF, Formas, Vinnova, VR, STEM, SIDA, FFSC, AFC and EU. In 2009, two projects at the department were financed by the European Union. Projects financed by VR and AFC are two-year projects, and the remainder last for 1 year. All PhD students are externally financed. The department has a budget of SEK 38 million for research activity in 2009, divided into SEK 25 million in external funding and SEK 13 million in internal funding.

PUBLICATIONS AND PATENTS

There are between 200 and 250 published articles from researchers at the department during the period 2005-2009. Additionally, 29 doctoral and licentiate dissertations have been produced at the department during this five-year period.

According to the RQ08-evaluation at Lund University (described in the introduction), 131 patents have been registered throughout the department between 2003 and 2007. However, new patents are continuously being applied for and tested. In addition, four spin-off companies have been established in the same time span.

FOOD, BIOTECHNOLOGY AND MICROBIOLOGY

At the Department of Chemistry, including both natural and technological science, research related to food and technology is carried out within the division of Biotechnology and at Applied Microbiology[23]. At the division of Biotechnology, food-related research focuses on enzymes, enzyme technology and enzymatic reactions in organic media. The research also deals with production of prebiotics and anti-diabetic food ingredients by enzymatic modification of carbohydrates as well as studies on antioxidants and production of food components with improved properties. In collaboration with the Biomedical Centre (BMC) and the Department of Food Technology, research focusing on thylakoids and appetite regulation is also being conducted.

In 2009, there were five ongoing projects related to food within the division: One project conducted as a four-year PhD project within the programme FUNCFOOD, two of the projects as two-year projects through the Antidiabetic Food Centre (in their second phase in 2009)[24], and two projects were financed by Formas over a period of 3 years. One of the projects was being conducted in cooperation with other universities and three of the projects were being operated together with partners from industry and public authorities. The division was granted external funding of approximately SEK 3 million in 2009 for food-related research (no EU funding). The division produced ten publications and one patent related to food between 2005 and 2009.

The food-related research at the division of Applied Microbiology primarily concerns the use of microorganisms in producing food, and developing methods to detect, for example, pathogen microorganisms in food. In 2009, there were four ongoing projects within the area of food, concerning bacterial toxin formation, the metabolism of lactic acid bacteria, Salmonella virulens and PCR-diagnostics. All of these projects were conducted in collaboration with other departments and faculties outside the University of Lund, and two of them were also being conducted together with researchers at the University of Lund. Three of the projects were financed by Formas. Three of the projects also had cooperation partners in Denmark (DTU, University of Copenhagen, Arla Foods and Chr. Hansen). There were 10 people connected to the division, working on projects related to food, including a few guest researchers. During the fall semester of 2009, the division had four PhD students connected to the division, all 100% externally financed by Formas and EU funding. Additionally the division hosted two visiting PhD students working on projects related to food.

There have been about 20 publications produced by the division since 2005 (including academic articles and book chapters). The division has produced four doctoral and licentiate dissertations during the same time period. One patent has been registered at the division.

At University Campus Helsingborg, LU, a research group of 2 researchers and 1 student on scholarship, has made an inventory of microorganisms, which is the first of its kind in Sweden. This has resulted in many new microorganisms being discovered, and projects have been initiated based on analysis of this inventory. One of the primary projects deals with honey, fruits and berries. One hundred lactic acid bacteria come from this microorganism

23 Food-related research within the divisions of Biochemistry and Applied and Pure Biochemistry, also part of the Department of Chemistry, will be presented in Chapter 5.

24 FUNCFOOD and Antidiabetic Food Center will be presented further in the Chapter 5.

bank, and one important aim is to investigate new ways these healthy bacteria can be used to treat diseases. Although the group is located in Helsingborg, it belongs to the Department of Cell and Organism Biology and is part of the Faculty of Natural Sciences, University of Lund. The research activity within the group is primarily financed by Gyllenstiernska Krapperupsstiftelsen, and their main project on lactic acid bacteria from bees and honey is financed by Formas, Sparbanksstiftelsen Färs och Frosta, Helsingborg stad, Ekhagastiftelsen, the Swedish Board of Agriculture and the United States Department of Agriculture, Agricultural Research Service. The group has five internationally published articles and three articles in popular science journals.

RESEARCH IN THE SCIENCE OF FOOD – DENMARK

At the Technical University of Denmark (DTU) several departments carry out research with relevance for the area of food. At DTU Food – the National Institute of Food, research activity is divided into three main categories: Nutrition [25], Food Safety and Environment and Health. The institute has approximately 400 employees in total. Within the area of Food Safety, research is conducted in Chemistry and Exposure (e.g., biotoxins, food processing contaminants, human exposure and environmental contaminants), Microbiology and Risk Assessment (e.g., control of food-borne pathogens, applied microorganisms, diet and gut microbiology, epidemiology and risk modelling, and global spread of food-borne pathogens), and Toxicology and Risk assessment (e.g., allergy, biomarkers and bioactive compounds, cardiovascular diseases, GMO, nanomaterials and novel food). The research projects involve primary production as well as consumer issues, and health risks related to food, including infections, chronic diseases and potential hazards with new foods and food technologies.

At DTU Systems Biology, research focuses on the field of biological issues concerning cell mechanisms, evolution and biological diversity, industrially related processes and production in relation to fermenting and food technology. The aim is to develop products based on their molecular properties, biotechnology and food technology. Three research groups have been identified by LMC in Denmark as conducting food-related research:

- Centre for Microbial Biotechnology (CMB)
- Enzyme and Protein Chemistry (EPC)
- Centre for Biological Sequence Analysis (CBS)

Furthermore, at DTU Informatics, computer-based mathematical models are developed to play a central role in the industrial production of, for example, food.

At DTU Chemical Engineering in the Department of Chemical and Biochemical Engineering, research is carried out with a focus on bioprocess techniques and use of enzyme technology. The Centre for BioProcess Engineering and Centre for Biological Production of Dietary Fibres and Prebiotics are operating in the interface between biotechnology, process technology and mathematic modelling. Interesting research themes for the area of food may be, for example, how to better use biological resources, enzyme assisting processes and design in the production of bioactive food ingredients. Within this area, there is also ongoing research in

25 Research in the area of nutrition is described in Chapter 5: Food, health and nutrition.

methods for monitoring, modelling, formulating and stabilisation of the bioactive components. There are four groups identified by LMC Denmark as food-related research groups:

- Centre for BioChemical Engineering (BioEng)
- Computer Aided Product-Process Engineering Centre (CAPEC)
- Danish Polymer Centre (DPC.DTU)
- Centre for Energy Resource Engineering (CERE) (continuation of Centre for Phase Equilibria and Separation Processes)

Additionally, nanotechnology has become increasingly important in producing new and different products for food companies. At DTU Nano, research is carried out within micro- and nanotechnology and most of the projects are conducted in collaboration with industrial partners, also facilitating the use of research findings in professional contexts.

At the Faculty of Life Science, University of Copenhagen (KU LIFE), much research with relation to food is conducted at the Department of Food Science (IFV). The department consists of 218 employees and six research groups, all focusing on various dimensions of food science, technology, chemistry and microbiology:

- Food Chemistry
- Quality and Technology
- Food Microbiology
- Sensory Science
- Meat Science
- Dairy Technology

The research group Meat Science cooperates with the Department of Food Technology, Engineering and Nutrition, University of Lund, and guest speakers from Lund are invited to education courses.

At the University of Copenhagen, there is also a special area of Food Microbiology at the Department of Veterinary Disease Biology (IVP), also part of KU LIFE. The group is conducting research on microorganisms of importance to food safety and food spoilage. Furthermore, the research focuses on food-borne bacteria, how these bacteria are surviving in different environments and how dangerous they are to humans.

5. FOOD, NUTRITION AND HEALTH – FROM A MEDICAL, BIOMEDICAL AND PUBLIC HEALTH PERSPECTIVE

This chapter discusses research projects as well as teaching activities primarily within the field of food, health and nutrition, including medical and biomedical related food research as well as the field of public health. Important questions being raised concern how different food ingredients may affect the human body as well as pathologic conditions. The research being conducted focuses both on preventive medicine and the importance of food as well as functional food in order to understand, prevent and treat diseases such as type 2 diabetes, metabolic syndrome and obesity. However, malnutrition is also a major problem, not least among the elderly, which indeed makes it a central field of research. The area also concerns, among other things, research on appetite regulation and paediatric nutrition. The Functional Food Science Centre (FFSC) and Antidiabetic Food Centre (AFC), connected to the University of Lund, are great examples of well-known research centres and networks within the area of functional foods and food for diabetics.

The research as well as the teaching activity concerning food, health and nutrition from a medical and biomedical perspective, are spread out at a number of universities and departments in the Øresund Region. In many instances the work is also tightly connected to university hospitals, where cooperation between clinical and non-clinical scientists is well established. This is the case for much of the research activity at the Biomedical Centre (BMC) in Lund, as well as at the Clinical Research Centre (CRC) in Malmö, where scientists as well as practitioners from the university hospital in Lund work together on various projects. This chapter presents of a number of research projects and education programmes within the Faculty of Medicine, University of Lund as well as within the division of Biomedical Nutrition (LTH). The activity at the division of Applied Nutrition and Food Chemistry, presented in Chapter 4, is also important in the field of nutrition. Education and research activity at the department of Human Nutrition (KU LIFE) as well as the Faculty of Health Sciences (KU), and at DTU Food, the National Institute of Food in Denmark, will also be presented.

EDUCATIONAL PROGRAMMES ON FOOD, NUTRITION AND HEALTH IN BOTH COUNTRIES

At the University of Copenhagen, Faculty of Life Science, there are two programmes with direct relevance to food, nutrition and health, both including a medical perspective. The MSc programme in Human Nutrition is a two-year programme focusing on the importance of food in relation to human health. Subjects in the programme include nutritional food quality, nutrient metabolism and the effect of nutrients on health, both from national and global perspectives. There were 92 students registered as of 1 October 2009. 29 and 30 students were examined in 2007 and 2008, respectively.

At the MSc programme in Clinical Nutrition, on the other hand, students gain knowledge in the use of nutrients in the treatment of diseases. The programme primarily includes studies

in nutrients, disease, nutrition physiology and treatment. There were 47 students registered at the programme as of 1 October 2009. 11 students were examined in 2007 and 13 in 2008.

The Swedish as well as Danish medical programmes include central elements regarding nutrition and health, although in many cases they are integrated in other courses. However, the course Matvanor och Hälsa (Food habits and health), for example, is offered by the division of Nutrition Epidemiology, Department of Clinical Sciences, University of Lund, on the seventh semester of the medical programme. Other programmes may also have important elements related to food and nutrition even though they do not have a specific course on those topics. This may be the case for programmes in Public Health and International Health as well as other health-related programmes, often employing a wider perspective where food can be included in specific papers or as examples in the teaching[26].

RESEARCH IN FOOD, NUTRITION AND HEALTH – SWEDEN

FOOD AND APPETITE REGULATION

Research focusing on appetite regulation and energy balance, as well as on the influence of palatable food within these parameters, is conducted within a research group at the Department of Experimental Medical Science, Faculty of Medicine, University of Lund. The main project on appetite and energy balance is further divided in six sub-projects, which include both national and international partners. They have an overall aim of finding and understanding mechanisms and targets to control feeding behaviour with palatable food in order to achieve energy balance. The research group consists of 1 group leader, 6 students and 6 members from the Clinical Team Obesity Unit, Lund University Hospital. In total, 10 researchers are included in the network (where 3 are PhD students), representing different faculties and departments at the University of Lund. The group has produced at least 25 publications between 2005 and 2009[27].

DIABETIC RESEARCH, METABOLISM, OBESITY AND MALNUTRITION

Much research is being carried out, focusing on raising awareness of the relationship between food and diabetes and the factors that affect our metabolism and thereby also increase the risk of obesity as well as malnutrition. The Antidiabetic Food Centre (AFC) is an excellent example of a large commitment to research on diabetes and food in the south of Sweden. The centre started in 2007 as one of 15 research centres supported by the VINN Excellence Centre programme in Sweden. AFC primarily focuses on research and innovation antidiabetic research. Vinnova is investing SEK 70 million over 10 years, which is one-third of the total budget of about 22 million Euros. The University of Lund will contribute one-third and external partners including Region Skåne and private companies will invest the final third.

AFC has been active in phase 1 between 2007 and 2009, and is now starting phase 2. 42 research leaders have been engaged in about 15 different projects in phase 1, with involve-

26 Programmes and courses in Public Health from different perspectives are found at the University of Copenhagen and Roskilde University, as well as at Malmö University (also in cooperation with the University of Lund) and Kristianstad University Campus.

27 The data are somewhat uncertain as they are taken from the group's website and not confirmed personally by the research group.

ment from industry, Region Skåne, LU Innovation and Innovationsbron Syd. Phase 2 started in 2009, and seven projects were already running by October 2009. Researchers represent different departments within LTH, the Faculty of Natural Sciences and the Faculty of Medicine. AFC has nine main partners, which are private companies as well as public actors. In October 2009, one patent had been granted, but more had been applied for. At this moment, no publications of research had been made by the centre. However, 83 articles published by researchers involved in AFC have been reported to AFC between the years of 2007 and 2009[28]. The researchers may have written more.

Researchers focusing on issues related to diabetes can also be part of the University of Lund Diabetic Centre (LUDC), a consortium of research groups dedicated to these questions. The centre includes research from different areas but with a common focus on diabetes. Parallel with LUDC, the Diabetes Programme at the University of Lund (DPLU) functions as a research network, sponsored by the faculties in order to promote research within the field.

At the Department of Clinical Sciences in Lund (IKVL) and Malmö (IKVM), research is conducted in areas related to nutrition and health from different perspectives. For example, a group of four researchers in Lund is studying nutritional intake, growth and metabolism in infants and small children. Another group, consisting of five researchers, focuses on how polar lipids in one's diet may obstruct the development of tumour cells, but also how these lipids affect blood lipids. Furthermore, researchers are also conducting studies within the field of diabetology and endocrinology as well as within gastroenterology and nutrition. Six researchers are involved in research within gastroenterology and nutrition, and 14 researchers are part of the diabetic research. Clinical Nutrition is a separate division and a part of Gastroenterology and Nutrition. The division consists of about 20 dieticians conducting diet therapy and counselling at different clinics at Lund University Hospital. The clinical research has long been conducted together with researchers at the Department of Clinical Sciences and some are also working at the children's hospital at the university hospital. Besides being a clinical division, various research and development projects are also ongoing. These concern methods for diagnosing and treating malnutrition, studies of dietary treatments during the metabolic syndrome and metabolic effects of various supplements for dietary treatments, especially for patients with inborn/inherited metabolic disturbances.

Research on obesity is a major field, also on an international level, and there is important ongoing research within this field on both sides of the Øresund Region. At the Department of Clinical Sciences in Malmö, for example, research is being conducted on obesity surgery and how the entry for nutrition supply affects blood sugar level and sugar-regulating hormones. At the Department of Experimental Medicine in Lund, research on Molecular Endocrinology focuses on underlying molecular mechanisms in the development of metabolic diseases (e.g., obesity and type 2 diabetes), with the overall aim of finding new concepts for prevention of metabolic disorders.

FOOD AND NUTRITION EPIDEMIOLOGY

The research group in Nutrition Epidemiology at the Department of Clinical Sciences in Malmö (IKVM) studies the relationship between diet and development of cancer. The group involves six people, connected to the research activity on a more or less regular basis. They

28 These were reported to the AFC by the researchers themselves.

have 2 active PhD students and 1 PhD student has earlier defended a doctoral dissertation within this field.

There are six main ongoing projects within the research group. However, many of these projects have in turn resulted in minor projects, which are more flexible and conducted over shorter periods of time. Projects investigate, among other areas, folic acid and breast cancer, foods high in fibre and breast cancer, diet factors and breast cancer and fat, fatty acids and breast cancer as well as focus on cardiovascular disease and the metabolic syndrome. Several also work within a project *"Matmönster"*(patterns of food) and on chronic diseases in relation to breast cancer. Within this last project, researchers have cooperated with the National Cancer Institute. The group has also started a project on acrylamid together with Occupational Medicine in Lund and in cooperation with Stockholm University, Sweden and the Danish Cancer Society.

In the projects, data from the Malmö Kost Cancer cohort (MKC, Malmö Diet Cancer cohort) is processed and analysed. The MKC cohort is the result of an initiative by the Swedish Cancer Society in the beginning of the 1990s, with the primary purpose of studying the interrelationship between diet and cancer development. The cohort was established between the years 1991 and 1996 and includes 28 098 individuals, both men and women. MKC is also a part of EPIC, the European Prospective Investigation into Diet and Cancer, which includes about 20 similar cohorts in 10 European countries. In Denmark, the Danish Cancer Society, Institute of Cancer Epidemiology in Copenhagen, is one of two EPIC centres, where "Diet, cancer and health" is a Danish follow-up study with the aim of investigating the relationship between diet, lifestyle and cancer development. Researchers in the group produced 61 publications between 2005 and 2009.

All projects conducted at Nutrition Epidemiology in Malmö are conducted in cooperation with researchers from other departments at the University of Lund. All research activity is externally financed; in 2009, the group had SEK 2 million in external funding.

FUNCTIONAL FOODS, NUTRITION AND GUT HEALTH

Connected to the University of Lund, the Functional Food Science Centre (FFSC) is a multi-faculty, multidisciplinary centre, including the PhD programme FUNCFOOD as well as the earlier mentioned Antidiabetic Food Centre (AFC). The primary purpose of the centre/network is to gain new knowledge that is important in developing new food items with the ability to decrease the risk of obesity, type 2 diabetes and cardiovascular disease. The centre was established in 2001. In 2009, 40 senior research leaders were part of FFSC, half of them from the Faculty of Medicine and the other half from LTH. A small number of the researchers were from the School of Economics and the Faculty of Social Sciences in Lund.

The PhD programme FUNCFOOD started in 2003 and financed nine PhD-students as of 2009. The students came from five different faculties at the University of Lund (Faculty of Medicine, LTH, School of Economics, Faculty of Natural Sciences and Faculty of Social Sciences). Six different projects were ongoing at FUNCFOOD, where 3 of the projects were so-called tandem projects (i.e., 2 PhD students working together). The projects were being carried out within four research areas: food design to optimize the ecosystem of the colon; food design to optimize metabolic effects and/or satiety; product design and quality assurance in the production of functional foods; and, functional food science aligned with con-

sumer and market). In 2009, five publications (reviewed articles) had been produced within the FUNCFOOD programme.

The FUNCFOOD programme is financed by the University of Lund, Region Skåne and industrial partners and foundations, each contributing a third. The PhD students are financed 100% by the FUNCFOOD programme. The programme has a total budget of about SEK 40 million.

One research group at the Department of Experimental Medical Science in Lund carries out research on vascular effects of oat components, with the aim of defining which properties of beta-glucans and other oat components are essential for its lipid-lowering and vascular effects. The project is one of many projects within the Functional Food Science Centre and is also conducted together with the division of Applied Nutrition and Food Chemistry, LTH.

At the Division of Surgery at the Department of Clinical Sciences in Malmö (IKVM), one research group is focusing on the interaction between luminal bacteria, fibre and gut health from a wide perspective. Specifically, the group is working with Lb Plantarum, probiotics which can be used to create a process whereby polyphenols with an anti-inflammatory effect are released. By adding different combinations of fibres from fruit and berries and different lactobacillus, these abilities may be used in humans. There are nine ongoing research projects within the group. Three of them are being conducted together with other universities and with research groups at LTH and SLU as well as with other clinical divisions in Malmö and Lund, and two of them have public partners (no cooperation with Denmark). All projects are financed externally and during 2009, the group had external funding of SEK 1,2 million. The group has one ongoing EU project (EPIC PANACEA). Furthermore, they have four patents and two spin-off companies (Carponovum AB and Probi AB).

The research group consists of nine senior researchers and 25 PhD students. The PhD students are either externally financed or have a clinical employment at Region Skåne. Twelve PhD students connected to the research group have defended their dissertations between 2005 and 2009. Twenty publications with relevance for food and nutrition were published by the research group during the same period of time.

FOOD AND NUTRITION FROM AN EVOLUTIONARY PERSPECTIVE

One research group at the division of General Medicine, Department of Clinical Sciences in Lund (IKVL), deals with the evolutionary aspects of healthy eating and more specifically with Palaeolithic diet (the Palaeolithic time period occurred 2,000,000-10,000 years BP). The overall aim is to study prevention and treatment of cardiovascular disease and related metabolic disorders. The recommended diet consists of meat, fish, vegetables, fruits and nuts. According to an evolutionary perspective, the researchers state that this food, eaten during our evolution, also must be the most appropriate for our health. There are five ongoing research projects in the group/network, with the following Swedish titles: *"Paleolitisk kost vid diabetes och metabola syndromet"* (Palaeolithic diet in diabetes and the metabolic syndrome); *"Kitavastudien"* (The Kitava Study); *"Paleolitisk kost vid reumatoid artrit"* (Palaeolithic diet in rheumatoid arthritis), *"Paleolitisk kost vid IBS"* (Palaeolithic diet in Irritable Bowel Syndrome) and "Stroke in rural Indonesia". All five projects are being conducted in cooperation with other universities. The project *"Paleolitisk kost vid diabetes och metabola syndromet"* is being carried out in collaboration with the Department of Biomedical

Sciences, The Panum Institute, Department of Ecology, University of Copenhagen. Most research within this specific field is described to be conducted in spare time and is externally funded by 50%. External research funding was SEK 50,000 during 2009.

The group consists of a network of six researchers (currently no PhD students). One doctoral student has defended his dissertation within this specific field since 2005.

GERIATRICS AND FOOD FOR ELDERLY

At the Department of Health, Care and Society, the Faculty of Medicine, the University of Lund, the research group in the division of Geriatrics is working with risk factors related to osteoporosis and especially on the importance of minerals and trace elements for bone density. The group has used population studies (e.g., Malmö Kost Cancer and the study *"Gott åldrande i Skåne"* (Good aging in Skåne)). The research group is involved in three areas: clinical and epidemiological research in cognition; function, participation and rehabilitation; and geriatric nutrition. The last group aims at studying the existence and evaluation of malnutrition, strategies for intervention and interactions between nutrients and specific health conditions (osteoporosis, in particular). Studies have also involved development of methods concerning instruments measuring the diet and the possibility to influence malnutrition.

The research group consists of 2 professors (where of 1 is emeritus), 4 post-doc, 2 lecturers and 4 earlier PhD students that have continued in the research group. Additionally, there are 11 PhD students connected to the research group together with 16 people that act as test leaders, doctors, psychologists, curator, nursing instructor, computer engineer, nurse secretary and assistants.

Research with focus on nutrition among the elderly is also conducted at Kristianstad University, focusing on elderly people and problems with eating and malnutrition. The research within this field has also been carried out in collaboration with the University of Lund and the Faculty of Medicine. Several projects have been conducted within this field.

FOOD, BIOMEDICAL NUTRITION AND NUTRIGENOMICS

Research within the field of food, nutrition and health, with a biomedical focus, is also being carried out at the division of Pure and Applied Biochemistry, Department of Chemistry, LTH. As a sub-division of Pure and Applied Biochemistry, the division of Biomedical Nutrition researches the interface between Food Technology and Medicine, focusing on the role of food composition on the health effects of certain foods. New functional foods are mainly developed based on cereals, together with food companies and European partners. The division also focuses on antioxidants and bioactive compounds in food, the content of such compounds in beverages and food, and their physiological effects in human beings. The interplay between dietary components and genes in the consumer, the so-called nutrigenomics, are also in focus for researchers in biomedical nutrition, who study how new techniques in functional genomics can be used in order to investigate the health effects of certain foods and food components.

The division consists of two research groups. One group focuses on the importance of food composition for health consequences, with special focus on dietary fibre and antioxidants. The group participates in two EU Networks (NuGO and ECNIS) as well as the Nordic Network SYSDIET. The other research group primarily deals with clinical effects of intake of cereals

and the health effects of new, oat-based food products. Also being conducted are studies of the physiological effects of dietary fibres, in collaboration with the European Union, NoE, NuGO, NoCoE, and SYSDIET. SYSDIET, the Nordic Centre of Excellence in Systems biology and controlled dietary interventions and cohort studies, started in 2007 as a result of the need to enhance the scientific quality within the field. The centre gathers 12 research groups from Sweden, Denmark, Norway, Finland and Iceland in an effort to exploit nutritional systems biology tools in human dietary interventions, animal and cell culture studies. In Denmark, the Faculty of Life Science, University of Copenhagen and Aarhus University have joined the centre, as well as the division of Biomedical Nutrition, University of Lund.

The EU-funded Network of Excellence, NuGO, is funded by the European Commission's Research Directorate under the Food Quality and Safety Priority of the Sixth Framework Programme for Research and Technological Development. The aim of the project, whose full title is "The European Nutrigenomics Organisation: Linking, genomics, nutrition and health research" is to improve genomics research. The division of Biomedical Nutrition, University of Lund is one of, in total, 23 partners in the network, consisting of research organizations, universities and small and medium sized businesses (SME's) from 10 European countries. The project started in 2004 and was funded through December 2009. However, one of the network's aims was to continue the work in the future.

Another project connected to NuGo is "Lunutr," which consists of a group of researchers and PhD students at five different departments in Lund and Malmö (Biomedical Nutrition; Department of Medicine, Lund; Department of Endocrinology, Malmö; The experimental Cardiovascular Research Group, Malmö, and Department of Cell and Molecular Biology, Lund).

Finally, ECNIS (Environmental Cancer Risk, Nutrition and Individual Susceptibility) started in 2005 as another Network of Excellence programme, also operating in the context of the Sixth EU Framework Programme for Research and Development. There are 25 universities and institutes from all over Europe participating, including the University of Lund and the division of Biomedical Nutrition as well as the University of Copenhagen. One important dimension of this programme is to improve the scientific basis for the development of health-promoting food. ECNIS offers a basis for dietary advice formulation as well as development of functional foods.

During 2009, approximately SEK 1 million was funded by the European Union (in different projects). There is at least one earlier patent granted for the division.

The division of Biomedical Nutrition has eight researchers (including senior researchers, post-docs and guest researchers).There are 9 PhD projects and 7 PhD students are connected to the division (2 from other institutions). The PhD students are 100% externally financed. Since 2005, six PhD students have defended their doctoral dissertations.

RESEARCH ON FOOD, NUTRITION AND HEALTH – DENMARK

The Department of Human Nutrition (KU LIFE) carries out research within the field of human nutrition and on factors influencing eating habits in order to increase knowledge of how to prevent and treat dietary-related diseases. It was the first Danish institute in the science of

human nutrition and it now employs approximately 136 people, 87 of which are academic posts. The department consists of five research groups that, from different perspectives, deal with food and nutrition, prevention and treatment of obesity.

Paediatric and International Nutrition focuses on the impact of children's eating habits (between 6-18 months) on development and risk factors later on for non-communicable diseases (e.g., hormonal status and obesity). They also look at the effects of probiotics on children. This group consists of 23 employees, including teachers and researchers at various academic levels and 10 PhD students.

Prevention and Treatment of Obesity – Appetite and Energy Metabolism deals with how appetite and energy metabolism is regulated and what roles the macro- and micronutrients play. This group also considers how programmes against obesity can be improved and to what extent obesity can be prevented or treated with changes in diet, dietary supplements and functional foods. They also focus on nutrigenomics (e.g., the relationship between heredity, environment and obesity). The group consists of 39 employees in total, including researchers, teachers and assistants, as well as 7 PhD students.

Clinical and Experimental Nutrition, interested in the nutrition of patients who have special nutritional requirements, has 29 employees connected to the group (including 7 PhD students and 3 post-docs). Preventive Nutrition focuses, among other things, on the importance of dietary intake of specific foods and bioactive food components in relation to different health parameters. The group consists of 19 researchers, where 9 are PhD students.

Finally, the research group Sociology of Food is also included in the Department of Human Nutrition, but this group will be described in more detail in Chapter 8.

The University of Copenhagen also conducts a vast amount of research related to medical aspects of nutrition, mainly within the Faculty of Health Sciences. The faculty consists of clinical as well as pre-clinical departments, where the former conduct research in close cooperation with the university hospital. The Department of Biomedicine carries out research with the aim of generating new knowledge in prevention and treatment of illnesses such as type 2 diabetes, obesity, the metabolic syndrome and cardiovascular diseases, most often lifestyle-related problems. The Department of International Health, Immunology and Microbiology also conduct diabetes research from a biomedical and clinical as well as public health perspective.

At DTU Food, the National Institute of Food in Denmark, research is also focused on human nutrition, with the aim of increasing the knowledge about healthy food habits and preventing food-related diseases. The research at the institute deals with effects of nutrients and the content of nutrients in certain products and participates in interventions focusing on nutrition and health. The nine main research areas follow.

Biomarkers for nutrient and food intake: The research area focuses on the relationship between biomarkers for nutrients and foods and the risk of developing diseases such as cancer, cardiovascular disease and osteoporosis. The area includes five people (one of whom is a PhD student), working primarily with vitamins and with establishing a vitamin network. The group collaborates with the Danish Cancer Society, Research Centre for Prevention and

Health at Glostrup University Hospital (Denmark) and the University of Copenhagen (KU LIFE) as well as with the Institute of Human Nutrition, United Kingdom.

Diet and health for elderly: There are two senior scientists connected to this specific field of research, with a focus on nutritional status among the elderly and its relation to functional abilities. One main project deals with developing "Tools for nutritional therapy," which is a part of the larger project "Good Food – Good Life"[29] focusing on those people who receive meal services. Among their collaborators are the NORA group (Nordic Research on Aging), the Danish Heart Foundation, the University Hospital in Copenhagen and the Danish Veterinary and Food Administration.

Dietary habits, nutrient intake, and physical activity: The group has, since 2000, conducted the Danish National Survey of Dietary Habits and Physical Activity among the Danish population, investigating the determinants of dietary habits and the interrelationship between dietary and nutrient intake, meal patterns, physical activity and health. Among the collaborators are the Danish National Institute of Social Research, the University of Copenhagen, the Netherlands Organization for Applied Scientific Research, and the German Institute of Human Nutrition, just to mention a few. There are 13 people (2 of which are PhD students) connected to the group.

Dietary interventions: This group conducts interventions that are either food-based (e.g., fruit and vegetables interventions, school meal interventions and interventions in canteens at workplaces) or nutrient-based (e.g., fortification or supplementation programmes including food-based interventions and nutrient-based interventions). They have collaborating partners among the Danish as well as European universities, such as the Institute of Human Nutrition (University of Copenhagen), the Department of Systems Biology (DTU), Roskilde University Centre and the University of Newcastle (United Kingdom), but also at the University of Lund (Sweden). There are 10 people (including 6 PhD students) within the field of food-based interventions and 6 people (including 1 PhD student) working with nutrient-based interventions.

Food and nutrient recommendations compiles and evaluates food-based dietary guidelines and nutrient recommendations in order to provide authorities and health professionals with important knowledge in preventing lifestyle-related diseases such as overweight/obesity. Two of their main projects are "Six a day – Latest documentation and recommendations," focusing on the consumption of fruit and vegetables, and "Guidelines for healthy meals served at schools and pre-school". There are five researchers connected to this area.

Food composition databases: The researchers in food composition databases have developed the Danish Food Composition Databank, which is comprised of over 1,000 Danish food items with up to 113 nutrient values for each food. The research conducted includes, for instance, monitoring the development of the food market and developing new database systems. The group collaborates with, among others, the Danish Veterinary and Food Administration and partners within Euro.FIR and NordFood (National Food Administration in Sweden included). Four researchers are working within this field.

29 The project is run by the National Board of Social Services, which is a subdivision of the Danish Ministry of Social Welfare.

Metabolomics is used to address the combined effects of components to assess health and determine the risk of food and food processes in relation to health. As many of our lifestyle-related problems are metabolic issues, metabolomics are considered a key to understanding how humans are affected by chemicals. There are eight researchers (one of whom is a PhD student) focusing on these issues. The group also cooperates with the department of Systems Biology (DTU) and the Faculties of Life Science, Health Science and Pharmaceutical Sciences at the University of Copenhagen.

Nutrient in foods (including bioactive compounds, macronutrients, minerals and vitamins): The research focus is on developing and validating analytical methods for establishing new values for bioactive compounds, macronutrients, minerals and vitamins, as well as studying the transformation and degradation of nutrients in food processing and cooking. The group cooperates with, among others, the University of Copenhagen, the Danish Cancer Society and Karolinska Institutet, Sweden. There are researchers (1 of whom is a PhD student and 1 of whom is a student) working within the different fields included in nutrient in foods, and there are 9 main projects active, most of them focusing on vitamin D.

Nutrigenomics. Research in nutrigenomics focuses on better understanding the interrelation between diet and genetic dispositions to illness, and in so doing, contributing to the development of healthy food for people with special dietary needs. There are 4 main ongoing projects and 5 people (1 of whom is a PhD student and 1 of whom is a student) connected to this field of research. Their collaborators include, among others, the University of Lund, and they also manage the Danish Research and Innovation Platform on Nutrigenomics, owned by LMC (the Centre for Advanced Food Studies).

6. FOOD – PACKAGING LOGISTICS, DEVELOPMENT AND DESIGN

A large proportion of our transports are related to food and food products, which makes the field of packaging as well as logistics extremely important in the food sector. The division of Packaging Logistics, Department of Design Sciences, LTH, Lund, carries out research with focus on traceability in the food chain. Packaging Logistics deals with developing and supporting the supply chain from packing until the product reaches the consumer. The research activity also focuses on consumer demands regarding package design and material. Packaging Logistics handles design, materials, information systems, standards, modularisation and so forth. Packaging Logistics considers how the package can add value to the product – starting with packaging design process - and how it can be integrated in the product development process.

STUDIES IN PACKAGING LOGISTICS, DEVELOPMENT AND DESIGN – SWEDEN

Studies in packaging logistics in Lund are an integrated part of the programmes in Design Sciences. The division of Packaging Logistics offers three master's courses (Packaging Technology and Development; Packaging Logistics; and, Simulation of Packaging and Logistics Systems). Technology Management is another master's level two-year programme offered in collaboration between the Lund Institute of Technology (LTH) and the School of Economics and Management, University of Lund. There is also a programme in logistics service management at the University Campus Helsingborg. The programmes and courses offered do not include any course with specialisation in food. However, as a result of the majority of the transports being food related, it is an obvious and integrated element in the education.

At Malmö University, there is also a course in Packaging Design (15hp), relevant in designing packages for food products.

STUDIES IN PACKAGING LOGISTICS, DEVELOPMENT AND DESIGN – DENMARK

In Denmark, full programmes on food packaging at a university level do not exist, but the subject is integrated in other programmes mentioned above, such as the MSc programme in Food Technology at The Technical University of Denmark (DTU). And private teaching institutions offer courses on various aspects of food packaging (see Chapter 10). DTU offers a two-year MSc in Materials and Manufacturing Engineering, a multidisciplinary programme focusing on materials in high-tech industrial areas, including the food industry.

RESEARCH IN FOOD, LOGISTICS AND PACKAGING DESIGN – SWEDEN

There are four PhD students at the division of Packaging Logistics (LTH), working on projects related to food and packaging. Three of the projects are 100% externally financed by, among others, Vinnova, NGIL, the Swedish Board of Fisheries, Region Västra Götaland and Region Halland. The fourth PhD student is financing her studies with private funds. Besides these partners, Skånemejerier, LRF, Tetra Pak and ABB are examples of other financers for research projects in the division. Besides the PhD students mentioned, there are three senior researchers in the division that carry out projects related to food. In total, 7 out of 15 researchers in the division are involved in food-related projects.

There were 11 main, ongoing research projects including the four PhD projects, related to food in December 2009, all based on close relations with industry. The majority of the projects dealt with traceability in the food chain from different angles. The PhD projects dealt with traceability in the food chain for frozen as well as chilled food, including critical elements in the food traceability chain and as well as consumer aspects related to food traceability. The fourth PhD student was carrying out research about innovations in the food and packaging sector. One industry-based research project dealt with innovative food logistics in collaboration with the companies ICA, Coop, Dagab, Schenker, Frigoscandia, Tetra Pak and Procordia. The purpose was to study the conditions for using traceability to create added value. A virtual model was created with the purpose of demonstrating how different players are involved in the food supply chain and how factors like temperature and informational factors affect the food.

Another project, called "New innovation logistic solution for small scale food processing," has the overall aim of developing a model for how to transfer knowledge from academia to practical implementations. The project is financed by the Swedish Board of Agriculture. Another project, "New technology for food safety control – Innovative methods for increased safety in food supply chains," is operated together with the division of Atomic Physics at LTH, with the aim of testing and evaluating a certain technique to ensure safety and quality in packaged meat products[30].

As mentioned above, the majority of the research projects in the division consider traceability issues in the food chain. One such project is operated together with SIK and financed by Vinnova, while another is conducted in cooperation with researchers at SLU Alnarp, connected to the EU-project "Traceback"[31]. Additionally, a project on food waste is operated together with Skåne's Food Innovation Network. Another potential project regards climate and traceability, based on a multidisciplinary approach including researchers from social and cultural sciences. The division of Packaging Logistics has also collaborated on projects with the Blekinge Institute of Technology, Sweden.

30 The new laser spectroscopic technique (GASMAS) has been developed, which can be used to monitor foodstuffs once packed without having to destroy the package.

31 Traceback is a project within the EU Sixth Framework Programme. It is funded with 16 million Euros and has 28 partners in 11 countries. Sweden is represented by the Swedish University of Agricultural Sciences (SLU).

There are two main research programmes where Packaging Logistics is involved: Product Innovation Engineering programme (PIE-p) and Next Generation Innovation Logistics (NGIL). PIE-p is a national research programme financed by Vinnova and Innovationsbron with the aim of strengthening relations between academia and industry regarding product- and business innovations. The programme started in 2007 and is a 10-year programme. NGIL is a VINN Excellence Centre also aiming to facilitate more productive relations between academia, private enterprise and public partners.

PATENTS AND INNOVATIONS

A couple of patents have been granted to researchers connected to the division of Packaging Logistics. One project has, in cooperation with Kemicentrum, the Department of Food Technology, Engineering and Nutrition and Packaging Logistics, developed a sensor that can measure viscosity and glycemic index, which is to be patented. The project is financed by Skåne Food Innovation Network, Innovation at Interfaces and LU-innovation. Furthermore, there are also two patents and one in working process at SIK, connected with the division of Packaging Logistics.

PUBLICATIONS

There have been 15 publications with relevance for the food sector published by the division of Packaging Logistics since 2005, including journal publications, books and reports. At least one doctoral dissertation has been produced within the field of food and logistics since 2005. However, two more may be relevant within the field. Two licentiate dissertations have been published within the field since 2005, both of them now continuing their studies for a PhD degree.

RESEARCH IN FOOD, LOGISTICS AND PACKAGING DESIGN – DENMARK

In Denmark, Risø DTU conducts research on the use of biopolymer materials in food packages. About 40% of all plastic production serves the packaging industry and about half of this is used in food packaging. From the viewpoint of environmental and sustainability issues, ongoing research deals with plastic produced from biopolymers which are manufactured from renewable resources. “NanoPack”, a project focusing on this specific field at Risø DTU, is investigating the qualities of the materials in order to achieve necessary heat and mechanical stability. Using nanotechnology is also a means of producing bioplastic food packaging with consideration for the environment. The project is multidisciplinary and includes researchers from five different groups.

7. FOOD – MANAGEMENT, ECONOMY, INNOVATIONS AND FOOD SERVICE

This chapter relates to the education and research area conducted within schools of economics and management in the Øresund Region, as well as the area of food service from a wide perspective. Research within economy, management, innovation and marketing with relevance for food are primarily conducted at the School of Economics and Management, University of Lund, Copenhagen Business School and DTU Management in Copenhagen. The multidisciplinary field of food and meal services is, for example, dealt with at the Department of Planning and Development at Aalborg University and by the Research Group for Nutrition and Sustainability in Novel Foodscapes at Aalborg University in a department physically located outside of Copenhagen. The teaching activities located to the University Campus Helsingborg and their programmes of Food- and Service Management will also be included in this chapter.

ECONOMIC ANALYSIS, INNOVATION AND CONSUMER BEHAVIOUR

The Lund Institute of Economic Research is the research division of the Lund University School of Economics and Management. Research activity, funded by external grants, is divided in 12 main research programmes and into a number of special area research programmes. One of these programmes is Lund International Food Studies (LIFS), which connects researchers with a common interest in food. The programme functions as a platform for researchers primarily interested in marketing and consumer aspects of food. There are 21 researchers connected to the programme, most of them belonging to the research area of marketing but also strategic management and accounting. Of the 21 researchers, there are 3 professors, 12 doctors of economics, 1 senior lecturer and 5 PhD students.

The overall purpose of LIFS is to "capture and analyze the future dynamics of the Swedish food chain in international competition" (LIFS 2011). The research has a strong focus on consumer aspects and on understanding consumer behaviour in various contexts. Understanding the relationship between marketing intelligence and technology is another important focal point. Common themes within the research include the changing role of the actors in the food chain and the role of brands and private labelling. There are 12 main, ongoing LIFS projects being carried out, which cover a wide range of perspectives and areas, such as branding, consumer behaviour, competitiveness, corporate social responsibility, innovation and new product development, internalisation in food, and retail industries and retail.

Many LIFS projects are conducted in cooperation with researchers from other universities in Sweden. Additionally, there is also one EU-project called Netgrow conducted together with eight other European countries, which studies cluster leadership and innovation. Netgrow operates in cooperation with the Skåne Food Innovation Network. Another EU-project named baltfood deals with consumer trends and innovation in the food industry in the Baltic countries. The project aims to bridge business and science and to build networks consisting of stakeholders representing different countries in Europe (including Denmark,

Germany, Finland and the Baltic countries). The European Union is supporting the programme through its Baltic Sea Region Programme, 2007-2013. Baltfood is being carried out in collaboration with Øresund Food in Copenhagen and Skåne Food Innovation Network in Lund. Research within LIFS is also developed in collaboration with Stirling in Great Britain and Region Skåne as partners.

There have been seven doctoral dissertations published within the area of food at the School of Economics during the period 2005-2009. Since 2005, there have also been 10 LIFS-specific reports and one anthology published[32].

Regarding educational programmes for students, the School of Economics earlier arranged a course in European Food Marketing. However, the course was not part of the course selection during the fall semester of 2009.

A group of researchers from universities in Malmö, Lund and Halmstad, together with consultants and Skåne Food Innovation Network, is investigating the innovation process from a gender perspective. The project *"Makten över maten"* (power over food), managed by the University of Lund, is a qualitative research and development project with the main aim of strengthening food innovations through a gender perspective, and increasing awareness of gender and equality issues in the food innovation system in Skåne. The project consists of 3 researchers, 1 PhD student and 2 consultants. The project is financed by TIGER, which is funded by Vinnova to develop innovation environments with a gender and equality perspective.

At Copenhagen Business School (CBS), Denmark, research from various perspectives in relation to food is conducted. For example, research is being carried out with a focus on application and development of mathematical statistic models within business administration, with the aim of finding new models applicable to product development in food research. Additionally, at the Institute of Intercultural Communication and Management, CBS, research is conducted in relation to an intercultural comparative study on children's food socialisation. The study involves data from 11 European countries and includes research of the development of interventional programmes promoting healthy diets and exercise. The study is part of the multidisciplinary research project IDEFICS (Identification and Prevention of Dietary- and Lifestyle-Induced Health Effects in Children and Infants), which is a 13 million Euro project within the EU's Sixth Framework Programme, on childhood obesity. It started in 2006 and is planned to continue for five years.

At the Department of Marketing, CBS, research activity concerns, among other things, food products and food quality from a consumer and marketing perspective. One three-year research project, with the title "Consumer's application of nutritional information in the modern food marketplace", ended in 2009. Two senior researchers, 1 PhD student and 3 members of the Research Group for Consumer Behaviour, were the main participants in this project.

32 However, there is no register of the number of publications produced by individual researchers connected to LIFS since 2005.

Researchers at DTU Management (the Technical University of Denmark) are conducting research with focus on innovation activities within production and management. Knowledge within this field includes issues related to logistics and the supply chain. The institute was established in 2008 with the aim of combining perspectives from technology with those from social science in order to study planning, innovation and management. There are four primary, ongoing research projects at the institute with relevance for the area of food. One PhD project, "Healthy eating strategies for corporate dining – Embedding canteen take away activities," is an ongoing project lasting 2008-2011. Another PhD project has the Danish title *"Strategier til sundhedsfremme i kantiner ved hjælp af måltidselementer"* (Strategies for health promotion in canteens using meal components) (2004-2010). "Supply chain modelling for professionally prepared meals" is the topic of the third PhD project, while the fourth project concerns "Advanced planning in food supply chains". These projects are also related to food and meal services, presented later in this chapter.

BRIDGING ECONOMY AND AGRICULTURE

Economic analyses in relation to food and agriculture have been conducted at the former Swedish Institute for Food and Agricultural Economics (SLI), located in Lund. The Institute was founded in 1999 as a governmental agency commissioned to conduct economic analyses within the field of agriculture, food and fishing. In January 2009, the institute expired as an independent institute; the platform AgriFood Economics Centre was established by the University of Lund in collaboration with the Swedish University of Agricultural Sciences (SLU), with the purpose of bridging science and policy. The centre carries out economic analyses within the fields of food, agriculture, fishery and rural development, and they also maintain and develop economic programming models.

There are 18 researchers from the University of Lund and the Swedish University of Agricultural Sciences (SLU) connected to the centre. In January 2010, there were 22 ongoing projects within the different main areas. Since 2005 and including the former SLI, 13 publications, mostly reports, have been published at the institute and the centre.

The International Institute of Industrial Environmental Economics (iiiee), University of Lund, participates as one of eight partner organisations in an ongoing European Environment Agency (EEA) project run by the European Topic Centre on Sustainable consumption and production. The Copenhagen Resource Institute is the head organisation in the topic centre[33]. The project focuses on contributing to the transition towards sustainable consumption and production (SCP), by analysing the potential role of retailers in moving towards SCP. On the basis of this, recommendations are given to retailers and policy makers. An important objective is to participate in the discussion about the retail companies' role towards sustainable consumption and production and to provide policy makers with recommendations and frameworks within the area. This project also aims at assessing the role retailers play in shaping megatrends at the macro-economic level as linked to, for example, food and drink.

At the moment, there are 4 senior researchers and 2 PhD students applying to FORMAS for

33 The following partners are also part of the European Topic Centre on SCP: Federal Environment Agency, Germany, Wuppertal Institute, Germany; Wuppertal Institute collaborating centre on SCP, Germany; the Regional Environmental Center for Central and Eastern Europe, Hungary; Institute for Economic Research on Firms and Growth under the National Research Council, Italy; and, Environment Agency for England and Wales, United Kingdom.

the ability to continue their research (the application is for 3 years and a total amount of SEK 6 million).

In Denmark, the Institute of Food and Resource Economics (FOI), part of KU LIFE, was established in 2004. The institute conducts research within the areas of food, agriculture and natural resource management, which concerns production as well as consumption of food and non-food products from the agriculture, gardening and fishing sector. Research activity is, to a large extent, multidisciplinary, integrating economy, bioethics and science of law with social science perspectives, as well as with disciplines within the natural sciences. The institute also conducts research-based consultancy assignments, concerning economic issues regarding food, agriculture, fisheries and the environment, for the public sector. The educational programmes and courses offered at the institute focus on economic management of food, agricultural economy and natural resources[34].

At DTU Management, the research project with the Danish title *"Jordbrugs- og fødevaresektorens udviklingsmuligheder i et regionalt innovationssystem perspektiv"* (Expansion possibilities for the agricultural and food sector in a regional innovation system perspective) is being conducted together with the Department of Business Studies at Aalborg University and the consultancy company Gemba Innovation. The inspiration for the project was the many future challenges within the agriculture and food sector, including globalisation and climate changes. The aim of the project is to be able to use the knowledge gained in evaluating opportunities for development on regional levels within the agriculture and food sector.

At Risø DTU, the research project "Development potentials for agriculture and food production in the regional innovation system" perspective emphasizes future competition and market conditions for the Danish agriculture and food production sectors. Worth mentioning is that Risø DTU also issues certificates on radionuclide content in foodstuffs to be exported from Denmark.

FOOD MANAGEMENT, FOOD AND MEAL SERVICE

This part integrates research activities in the area of food related to service management and food and meal services from a wide perspective. University Campus Helsingborg (LU) offers a three-year multidisciplinary programme in Food Management, which aims at providing students with knowledge in economy as well as in natural sciences, food production, technology, social sciences and consumer behaviour. The programme is partly operated by the Service Management programme in Helsingborg, partly by the division of Food Technology (Department of Food Technology, Engineering and Nutrition), Lund. When started in 2008, 12 students participated in the programme, 10 of which are still active. Additionally, there were 18 new students starting in September 2009. The programme has many contacts with regional private companies, which plays a part in the teaching activity as well as in facilitating future job opportunities for students. Some partners are part of a so-called Advisory Board, where the companies play an active role in shaping the programme[35]. Following this movement, there is also an ongoing project for increased cooperation between

34 These are included in Chapter 3 in the list of studies offered by the Faculty of Life Science. The Institute of Food and Resource Economics (2010) offers 58 separate courses (according to their website).

35 This includes cooperation with, for example, Procordia Food, Fazer Amica and Cultimedia Information AB, Culinar AB and IKEA food service.

university campus and industry in the northwest of Skåne. The purpose is to inspire food companies to take an active role in shaping and defining food-related educational programmes and courses as well as to establish partnerships.

Six teachers are connected to the programme in Food Management (plus guest teachers), all of whom are employed at the LU Faculty of Engineering in Lund. Four of the teachers have a PhD's and two are assistant masters.

As part of the Department of Service Management at LU University Campus Helsingborg, students at the programme Hotel and Restaurant Management primarily focus on economy, marketing and management issues as well as socio-cultural aspects related to management of restaurants and/or hotels[36]. The programme started in 2000 as a four-year programme, but has been condensed into a three-year programme, with the possibility of continuing onto a master's programme. From 2004 (when the first group of students graduated) until 2006, 131 students graduated (after the four-year programme)[37]. In 2007, the first students graduated from the three-year programme and since then, 100 students have graduated from the programme. In October 2009, 163 students were registered, divided into three cohorts[38].

Almost 60 teachers and researchers are included in the staff at the Department of Service Management, but many of them alter between the different specialisations. As of 2009, ten people were teaching on a more regular basis at the programme Hotel and Restaurant Management - 4 senior researchers, 4 PhD students, 1 research assistant and 1 assistant master.

At the University Campus Helsingborg (LU), a graduate programme is offered in Service Studies and they have 9 PhD students. One of these students is working on a dissertation on culinary tourism and how culinary networks can be used as a tool in developing destinations. The study is conducted through a case study in cooperation with Culinaria *(Matrundan)* in the southeast of Skåne. The project is financed by Sparbanksstiftelsen and is a part of a larger research project called "Nature, culture, tourism and business development in Scania." There are at least three researchers with a research interest in food; however, none were involved in food-specific projects at the time of this investigation.

As part of Aalborg University, Denmark, the Research Group for Nutrition and Sustainability in Novel Foodscapes is located at a campus outside of Copenhagen. Researchers have a common interest in food and meals in public spaces and focus on food and meal services in, among other places, workplaces, schools and hospitals. The research group consists of 5 faculty-financed researchers, 4 PhD students and 7 researchers employed by special projects. There are also six students working on different projects related to the research group, though not employed. Everyone included, there are 22 people connected to this research group.

The researchers and PhD students in the group are working within three main areas of interest: the school/pre-school, the workplace and the hospital. The four ongoing PhD projects

36 It is difficult to define the extension of the relevance of the programme in the area of food.

37 It was also possible for the students to graduate after three years even during this period, but these are not included in the number mentioned.

38 Sixty-six of these started as new students in September 2009.

deal with different problems within these three areas. The PhD projects concern healthy eating and organic supply in schools, corporate nutrition responsibility and work-life balance analysis. Two of the PhD students are financed 50% by the university and 50% by their respective projects. One PhD student is externally funded by 1/3 and no information regarding financing of the fourth student was available at the time for the collection of the material for this report.

Besides the projects mentioned, there are four other projects also covering the range from school and pre-school to workplaces and hospitals. One project dealt with food in schools with the purpose of evaluating nutritional aspects of the food in school. The project ended in December 2009; it was conducted in collaboration with three universities and three private consultants. The other project about food in pre-schools, an EU-project, also ended in December 2009. The project cooperated with a university in Poland as well as a research institute and consumer organization in Italy. IPOPY[39], a project financed by Core Organic, was an ERA (European Research Arena) project. The project was active from 2007 until 2010. One PhD student was directly related to the IPOPY project. Obesity Governance, which started in November 2009, has one PhD student connected to it. The project is financed 60% by the European Union (the rest through co-financing).

39 iPOPY (Innovative Public Organic Food Procurement for Youth) aimed to investigate policies and instruments for an increased use of organic products in public food serving outlets for youth. iPOPY was a cooperation between Denmark, Finland, Italy and Norway, and had participants from Germany.

8. FOOD AND MEALS FROM SOCIAL, CULTURAL AND PEDAGOGICAL PERSPECTIVES

Food and meals from a social and cultural perspective is primarily a field of research, while courses depend on teacher capacity. Therefore, this chapter will largely present the research activity focusing on food and meals, and food as meals from social and cultural perspectives. The research focuses on attitudes and values toward food and meals in different contexts, such as in schools, workplaces or nursing homes. Understanding food and meals from a social and cultural perspective is also about acknowledging differences between people (consumers) according to age, ethnicity and socio-economic status, as well as personal preferences. The chapter also presents food and meals connected to the teacher education programmes from pedagogical perspectives.

Research related to social, cultural and pedagogical dimensions of food is conducted within various disciplines, at various faculties at the University of Lund including the Faculty of Social Sciences and the Faculty of Humanities and Theology, but also at the Lund University School of Economics and Management, presented in the previous chapter. The pedagogical activity related to food and meals is apparent in educational programmes and courses at both Kristianstad University and Malmö University. In Denmark, research is conducted at the University of Copenhagen and at Roskilde University, but also at universities not part of the Øresund University: the Danish School of Education and the Metropolitan University College in Copenhagen (see Chapter 10). In the next chapter, the field of gastronomy will be outlined, which include a variety of disciplines and perspectives, many of which have already been presented in previous chapters. In the same way, social, cultural and pedagogical aspects of food and meals are also important in studies and research within gastronomy.

A SOCIAL AND CULTURAL UNDERSTANDING OF FOOD AND MEALS

At the University of Lund, there are various ongoing research projects and some recently ended, focusing on social and cultural dimensions of food and meals. At the Department of Sociology, Faculty of Social Sciences, University of Lund, there are six main researchers that during the last five years have been involved in research projects concerning food and meals. The department has two main research groups, where food is an integrated part: Society, Development and Environment and Everyday Life and Life-World Research, including researchers with different interests in society, the environment and the everyday life. There is one ongoing research project, funded by FORMAS, which focuses on consumers and their everyday problems in solving food dilemmas regarding food preparation, food purchasing and inspiration in relation to food matters in everyday life: *"Matinspiration under tidspress"* (Food inspiration in a time crunch). Changes in constitutions of families as well as in society in general, new technologies and a changed food supply, established the starting point for the project. One part of this project is a PhD project, focusing on families with small children, while another part focuses on families with teenagers. The methods used are, among others, the so-called walk-alongs, where the researchers join the family members in a shopping mall.

The research mentioned above is aimed at better understanding food and meals within the family. Research has also been conducted at the same department with focus on the workplace, in trying to better understand the conditions for having meals at work, especially among those working irregular hours. This is also a way of connecting a consumer perspective to an organizational perspective in how time is planned, working-hours structured and breaks valued. This research provides knowledge about attitudes toward food and meals, as well as about today's working life. The research has been conducted as a multidisciplinary project as well as a doctoral project.

At the Department of Sociology, there is also a current research project with the Swedish title *"Handelns frontpersoner"* (the front persons of retailing). One project is an innovation project with employees in supermarkets as participants and financed by Vinnova. Another project, financed by Handelns forskningsråd, studies the development of competence among employees in, for example, convenience stores and gas stations, as well as on how to handle customer relations. Gas stations are as much food stores as a place for buying gas, which is pointed out as a motive for studying these arenas in a food consumer context.

At the Department of Cultural Sciences at the Faculties of Humanities and Theology at the University of Lund, several researchers at the division of Ethnology have, during the last decade, focused on food from a cultural perspective. However, some of these researchers are now working at the Department of Service Management at the University Campus in Helsingborg (described in the previous chapter). For example, in 2005 the analogy with the Swedish title *"Mat, genealogi och gestaltning"* (Food, genealogy and interpretation) was published in Lund, including several chapters written by researchers from the division of Ethnology and from the Department of Service Management in Helsingborg. The book includes discussions within the field of food and culture, pointing out complex questions about food, food origin and how people perceive local and global food. There are currently 3 researchers (1 senior researcher, 1 PhD student and 1 professor emeritus) located at the division of Ethnology with primary interest in issues related to food as cultural phenomena. Their research deals with food, food consumption and food production from a historical, contemporary as well as future perspective.

Combining the Departments of Sociology and Cultural Sciences at the University of Lund, there have been approximately 40 publications, including doctoral dissertations, produced within this specific field between 2005 and 2009.

At Roskilde University, the research group Health, Environment, Everyday Life and Food Production, a part of the Department of Environmental, Social and Spatial Change, consists of seven researchers, including PhD students. The group conducts research in topics related to interactions between humans and their environment as well as social and spatial conditions. One ongoing PhD project within the research group deals with the school as the meal arena and with the problems of introducing school meals for children.

The project, which ended in June 2010, was called "Children, school food provision and good meals – Introducing school food provision into everyday life of pupils".[40] It discussed how

40 The PhD was submitted for assessment with the Danish title Poetiske perspektiver på det gode skolemåltid - Børns muligheder som medskabere af skolens måltider *(*Poetic perspectives on the good school meal – Children's possibilities as co-creators of school meals*).*

the meal systems at schools are working in practice. The project was part of "Food+Lab", a research- and innovation project supported by DFFE (now *Dansk FødevareErhverv*) and conducted in cooperation with, among others, the Confederation of Danish Industry (DI) and the National Food Institute at the Technical University of Denmark. The PhD project mentioned above was one-third funded by this project, the remaining two-thirds coming from *Det danske forskningsråd* and from Roskilde University.

In addition, it should be mentioned that a project concerning food innovation is being carried out at the Centre for Experience Research.

At the Department of Human Nutrition, KU LIFE, the research group Sociology of Food focuses on the social and cultural as well as political and economical aspects of the food chain in order to promote health, sustainability and consumer interests. The research group has a cross-disciplinary approach, which includes many disciplines within the social sciences. The group takes part in several projects within LMC (Centre for Advanced Food Studies) and they cooperate with researchers from the Centre of Bioethics and Risk Analysis (CeBRA), which focuses on consumer perceptions of new technology and new production methods. The group also participates in several cross-scientific cooperations within KU LIFE, studying the environment and organic farming. There are 15 researchers in the group, including 5 PhD students.

At the University of Copenhagen's Institute for Anthropology, one scientist and one PhD student are studying food from an anthropological perspective. The PhD is researching consumer preferences in relation to grain products in the Nordic countries. The PhD project is a part of a pan-Nordic, multidisciplinary project with the title "HELGA Nordic Health – Whole grain food," financed by the Danish Cancer Society and the Nordic Council of Ministers and including researchers from health and agriculture from universities in all Nordic countries, including SLU in Sweden.

CONSUMER, POLITICAL AND ENVIRONMENTAL ASPECTS OF MARKETING AND LABELLING FOOD

Research projects have also been conducted in relation to how consumers relate to and perceive food and food labelling in different contexts. The Research Policy Institute (RPI) in Lund was founded in 1966, based on a grant from the Bank of Sweden Tercentenary Foundation, and was formally established in 1979. It was one of the first organisations in Sweden to focus on "research about research". The Institute became part of the Faculty of Social Sciences, University of Lund in 1990; however, it was transferred to the School of Economics and Management, University of Lund in 1999. RPI got their first PhD programme in research policy in 2007, however many graduate students had done their work at the Institute before that. One PhD student is currently working on a project with the title "Stakeholder dialogue in EU food safety domain" (DG SANCO), dealing with stakeholder participation within the European Union´s core political and scientific institutions, which are the Directorate General for Health and Consumers and the European Food and Safety Authority (EFSA).

Another research programme at RPI is called GreenGovern and was financed by Formas, 2006-2009. The project title is: "Participation, deliberation and sustainability. Governance beyond rhetoric in the domains of climate, forestry and food safety". A research group, consisting of four researchers from disciplines of sociology and economics, has participated in

projects regarding food, policy and consumer power. One project, "Challenges of green consumerism: International comparisons of food labelling, forest certification and green mutual funds", dealt with food consumption and labelling in relation to environmental and social issues. This particular project was financed by Formas for about SEK 3 million over three years (2003-2005), and is one example of an interdisciplinary approach to the area. The project has also resulted in a number of publications in terms of articles as well as a report.

FOOD AND MEALS FROM A PEDAGOGICAL PERSPECTIVE

Food is also studied from a learning perspective and for pedagogical aspects. Kristianstad University offers a specialisation in Home Economics as part of the 4.5-year Teacher Education programme, which has a clear focus on food and meals. The programme includes courses in food and nutrition, food and meal culture in multicultural society, as well as trains students to prepare for and arrange culinary meals, taking into account health and environmental aspects, gender issues and questions about resource management. Students are partly studying together with students from the programme Culinary Arts, Food and Meal Sciences, and the teachers are also alternating between the programmes (this will be expanded upon in the next chapter).

In the beginning of the fall semester in 2009, 64 students were registered either at the programme, on separate courses or through the distance learning. Because the specialisation is rather new, only 12 students have been registered as graduating during 2008 and 2009.

Malmö University also offers separate courses related to food. The course Food, Climate and Learning for Sustainable Development" is offered for people already holding a teacher degree. This is either a 15 hp course for teachers that are part of a teacher team or a 7.5 hp course for practicing teachers in the later years of elementary school or high school. The course addresses: the relationship between food and climate, food from ecological, social and economic perspectives, and how teaching in environmental issues has changed over time.

The Danish School of Education (DPU) is a part of Aarhus University, though physically located in Copenhagen. They have a number of current as well as finished projects focusing on, among other topics, children's eating habits and how to teach children to eat healthier as a pedagogical challenge. In this way, the projects concern learning aspects and "consumer education" in relation to food and meals. One project is a comparative study conducted in Denmark, Sweden, Norway and Finland on ninth graders' conception of food and health. Another project involves an interview study of home economics students and their teachers' views and perceptions of home economics in school. A recently concluded project dealt with evaluations of interventions regarding admission of healthy food in school canteens.

FOOD AND ADVERTISING

At the Department of Media and communication at the Faculty of Social Sciences at the University of Lund, researchers have been interested in children and advertising, especially in relation to unhealthy food. An earlier project (2005-2007), funded by the Nordic Council of Ministers and the Swedish Consumer Agency, was concerned with advertising and the commercial influence on children younger than 13 years old. The purpose of the project was to map the marketing of food in Sweden, with a special focus on unhealthy food directed towards children. There are also two pending applications at the department, one concerning a project dealing with food advertisement in new media, the other a comparative study

of how food is represented in Swedish and US media from a public health perspective. This project is operated in collaboration with John Hopkins University, USA. At least 10 different publications (articles and reports) have been published at the department within this field between 2005 and 2009.

9. WHAT ABOUT GASTRONOMY? – INTEGRATIVE PERSPECTIVES ON FOOD STUDIES

In this chapter of this report, the concept of gastronomy will be outlined. Gastronomy is in a way "tying up the sack", including all the fields of food studies presented in this report. Gastronomy is about using all the senses in trying to understand food and its essences as well as in trying to develop new flavours in new and existing products. This means that gastronomy, in many ways, demands a multidimensional approach to bridge the chemistry and nutrients of food with the social and cultural dimensions. However, gastronomy also includes a special and important dimension: aesthetics, the presentation and sensory aspects of food and meals. It is about consumer experiences, communicating food and the enjoyment of food and meals. Gastronomy is about creating pleasure in food, and filling it with more values than just the pure value of nutrition.

At Kristianstad University, Sweden, the three-year programme in Culinary Arts, Food and Meal Sciences (*Gastronomiprogrammet*) started in 2004 with the aim of filling a gap in food studies in the region. The main subject of the programme is Food and Meal Science, and it has a clear focus on gastronomy from a wide perspective. The programme is theoretically as well as practically oriented and includes courses in a number of fields related to food, from microbiology, food safety and nutrition to business economy, product development, communication, sensory aspects and meal experiences. As part of the programme, the students are also participating in education located at different food industry companies, giving them the opportunity to make contacts for future job opportunities in the region. The students that have graduated from the programme are working within, among other areas, product development in the food industry, restaurants and catering, the event industry and the packaging industry. The market research agency Synovate is also involved in the programme and is responsible for certain courses in sensory science.

Since the programme started in 2004, approximately 60 students have graduated (the first group in 2007), obtaining a Bachelor of Social Sciences in Food and Meal Science. In September 2009, 40 new students were registered at the programme, adding up to 65 active students in the first, second and third year of the bachelor's programme at the time of this investigation.

There are also a number of supplementary courses available in the field of Food and Meal Science in the areas of food, nutrition and health, food chemistry, microbiology and food hygiene, food safety and legislation, and communication and entrepreneurship in relation to food and meals. Furthermore, the 7,5 hp course Gastronomy. A Global and Interdisciplinary Perspective is offered in collaboration with the University of Lund, with the aim of providing insights into gastronomy, sensory studies and food processing, as well as into how gastronomy can be a part of nutrition and society.

Within the area of Food and Meal Science, there were 24 teachers and researchers involved in the education programmes and courses in the fall semester of 2009. About 10 people were more permanently involved in the teaching activity at the programmes, while others were primarily connected to other areas at the university campus or were guest speakers within a specific field.

At KU LIFE at the University of Copenhagen, the programme in Gastronomy and Health is offered as a two-year candidate programme (MSc). The programme integrates knowledge about nutrition and food safety with gastronomy and consumer perception of food and meals. By using knowledge from disciplines such as chemistry, physics and sensory science, students are developing their skills in creating healthy, tasty and aesthetically attractive food. Similar to the programme at Kristianstad University, the students in the programme of Gastronomy and Health also combine theory with practice, including molecular gastronomy. In October 2009, there were 17 students registered in this programme.

At KU LIFE there is also a cross-disciplinary, two-year international MSc programme in Sensory Science, focusing on human perception of sensory input. The programme aims at increasing knowledge in how senses react during food intake, how it influences food choices and eating behaviour and how our senses can be used in quality control and product design. Observations take place in controlled natural contexts, for example, in the "restaurant of the future" at Wageningen University, the Netherlands or in the "supermarket of the future" at KU LIFE. Ten students started the programme in September 2009. The students spend one semester at Wageningen University and 2 semesters at the University of Copenhagen. The second year, students may choose either Wageningen or Copenhagen as the base for their studies.

Research on gastronomy is also taking place at KU LIFE. In a four-year research project on Molecular Gastronomy, the Department of Food Science combines sensory science and food chemistry and involves cooks and restaurants to do research on the physics and chemistry behind consumers' gastronomic experiences.

10. OTHER PLATFORMS FOR PRIVATE AND PUBLIC RESEARCH AND EDUCATION

The main focus of this report has been on stakeholders related to food studies coming from universities. But many stakeholders are not from universities. Instead, they may be private institutes or act in the interface between the public and the private sector. A selection of these will be briefly mentioned here.

The Danish Meat Trade College (DMTC) in Roskilde offers programmes combining theory and practical training within among others two new programmes in food technology and nutrition technology. These are two-year programmes, targeting kitchen assistants, nutrition assistants, cooks, butchers and students. The main areas for training and education at DMTC are, among others, the slaughter- and meat industry, food processing, meat inspection, catering and restaurants.

Similarly, the Metropolitan University College (formerly *Suhr´s Seminarium*) in Copenhagen offers two 3,5-year professional bachelor's in Nutrition and Health and in Global Nutrition and Health. A number of diploma programmes are also offered with the aim of improving professional skills in the areas of nutrition, food, consumption, health, etc.

GTS – Advanced Technology Group acts as the industrial organisation for all nine Authorised Technological Service Institutes in Denmark. An Authorised Technological Service Institute is a non-profit organisation that has been authorized by the Danish Ministry of Science, Technology and Innovation to use the appellation. GTS Advanced Technology Group is a grouping of independent Danish researchers and technological organisations with the aim of developing and offering technological services within different specialist fields. Customers are private businesses as well as public authorities. The grouping is described as one of Denmark's largest consulting networks, offering services nationally as well as internationally. One of the Authorised Technological Service Institutes in Denmark is the Danish Technological Institute which is one of the world's largest private institutes. The institute's purpose is to supply technological services to companies and public organisations and to secure that new knowledge and technology can be used in developing new products, materials and methods. The institute develops projects in cooperation with researchers nationally and internationally, as well as with companies. Among the focus areas of the institute are innovation and competitiveness, sustainable exploitation of resources and food packaging. Another Authorised Technological Service Institutes with relevance to the field of food is DHI Water and Environment. DHI aims to promote technological development in areas related to water, environment and health (including food safety), with emphasis on developing knowledge and technologies concerning ecology and water resources. DHI participates in national and international research projects, and offers educational courses and consultancy services.

In Sweden, there are a number of platforms connecting universities with private institutes and corporations. Meny is a cooperation between the Swedish University of Agriculture, SIK (the Swedish Institute for Food and Biotechnology), the University of Lund, Umeå University and Linnaeus University in Sweden. The platform offers education programmes for small- and medium-sized companies in the food sector and increases relations between research and food industry. Meny is working with, among other tools, web-based education and mentor programmes, where the latest research results are applied in practice in the food industry. Meny offers courses in, for example, food safety, health and biotechnology, and production and the market.

Centrum för Livsmedelskvalitet (CLF, Centre for Food Quality), connected to Kristianstad University, coordinates and develops courses for professionals within the food sector. The courses cover food safety, food quality, hygiene and food legislation, food and meal culture, nutrition and health. Kristianstad University Uppdrag AB, owned by the University College, focuses on offering companies and organisations academic expertise. One of their focus areas is Food and Meal Science.

Livsmedelskollegiet, established in 1977, has the purpose of promoting food research in southern Sweden and increasing cooperation between stakeholders in the field. *Livsmedelskollegiet* consists of institutes and departments at the University of Lund, the Swedish University of Agricultural Sciences in Alnarp, Kristianstad University and companies within the food area.

The Swedish Nutrition Foundation (SNF) was established in 1961 under the name *Stiftelsen Svensk Näringsforskning*. The purpose of the foundation is to support research within nutrition and related areas, and to be able to implement it practically as well as theoretically. SNF engages four people who work with the foundation; they have about 40 members consisting of food and pharmaceutical companies and organisations.

The Swedish Institute for Food and Biotechnology (SIK) is an industrial research institute aimed at strengthening the competitiveness of the food industry. The institute is located in Lund, as well as in Gothenburg, Umeå and Linköping in Sweden. The institute conducts strategic as well as applied research for the industry in joint industrial projects. Moreover, SIK also offers consultancy services in product and process development. The annual turnover is about SEK 90 million, where two-thirds come from industry (in the form of assignments and membership fees) and one-third comes from the Research Institute of Sweden, EU, Vinnova and other research foundations and councils.

11. RESEARCH CO-OPERATIONS, FOOD CENTRES AND NETWORKS, AND INNOVATION-SUPPORTIVE ORGANISATIONS

Food research at the universities in the Øresund Region is to a large extent part of interdisciplinary programmes, networks and clusters that gather researchers, PhD students and students from different disciplines, as well as stakeholders from private companies and public authorities. This chapter presents an overview of the public and private initiatives that work to coordinate research and education, bridge science with industry and authorities, and assist in the process of commercialising research ideas.

First, multidisciplinary research- and PhD programmes and food centres at universities in the Øresund Region will be presented. Second, food innovation centres and network organisations, aimed at bridging food research ideas and private and public interests, will be lined up. Finally, two chapters will approach topics "From research to commercialisation" in the Øresund Region by looking into Tech Transfer Offices and other innovation-supportive organisations" and "Science Parks and incubators – Platforms for innovative ideas to grow".

MULTIDISCIPLINARY RESEARCH- AND PHD PROGRAMMES AND FOOD CENTRES AT UNIVERSITIES

PHD PROGRAMMES

In Sweden, as well as in Denmark, there are a number of interdisciplinary research programmes, networks and PhD programmes related to food. In the previous chapters, several programmes have been mentioned; some of them focusing on a specific discipline or subject of interest (for example *Sensys* mentioned in Chapter 3, and NGIL in Chapter 6), while other have a multidisciplinary approach. The research school FOOD is probably the most well-known PhD programme within food science and nutrition in Denmark. About 150 students are connected to the programme, about 90 of which are from KU LIFE, 30 from DTU and 30 from Aarhus University in Jutland. In Sweden, the national research school LiFT, *Livsmedelsproduktion med framtidens teknologier* (food technologies for food production), has 28 PhD students from the University of Lund as well as from Gothenburg and Uppsala. The research school LiFT has close connections to industry and the PhD students also have a personal mentor at an industrial company. Each year around 30-40 PhD students are connected to LiFT; more than 30 PhD students have defended their dissertations here since 2005. As a supplement to LiFT, the Swedish Agricultural University (SLU) manages the research school Food in Focus, which supplies a connecting platform for Food Science PhD students at SLU and also caters to international students not speaking Swedish and with a job future outside of Sweden. The number of PhD students associated with the program in 2009 was 18.

PhD students with a research focus on functional foods may also be connected to the PhD programme FUNCFOOD mentioned earlier (see Chapter 5). The students come from five dif-

ferent faculties at the University of Lund. However, besides the various activities arranged by the programme, the students are physically located at their respective departments. Also a part of the Functional Food Science Centre (FFSC), the Antidiabetic Food Centre (AFC) presented in Chapter 5 gathers over 40 research leaders from different faculties at the University of Lund to engage in projects with close industrial relations.

FOOD CENTRES LOCATED AT UNIVERSITIES

LMC – Centre for Advanced Food Studies in Denmark, also previously presented, coordinates food-related research activity and education at five Danish universities, two of which are located in the Øresund Region (the University of Copenhagen and the Technical University of Denmark). In addition, Aalborg University, the University of Southern Denmark and Aarhus University have campus sites in the Øresund Region. It is worth mentioning that LMC also initiates various activities, networks and research conferences. Examples of LMC strategic networks are "Individual nutrition and health" and "Vitamins." There are approximately 620 food researchers associated with the 5 universities and the annual food-related turnover in 2008 was around 78 million Euros.

Food DTU is an international knowledge and skills centre within food science, encompassing 10 institutes at the Technical University of Denmark (DTU) that, to varying extents, carry out research related to food. The centre is engaged in research activities and education as well as consultancy and establishing partnerships with the industry. There are a total number of 2700 employees at these institutes, 1300 of which are researchers and PhD students, covering the chain from sea/soil to the consumer. Food DTU is the coordinator of 7 major EU projects and participates as a partner in 28 other EU projects (DTU 2010).

Food, Fitness and Pharma is a new multi-disciplinary research initiative at the University of Copenhagen, gathering 42 researchers from 17 different institutes and 6 faculties, with the aim of strengthening research on environmental, genetic and epigenetic causes of obesity, type 2 diabetes and other lifestyle-related diseases. The project is supported by a 16 million Euro grant from the Danish Ministry of Science, Technology and Innovation. Food, Fitness and Pharma started in September 2009 as one of 12 interdisciplinary research platforms at the University of Copenhagen.

Within the field of economy, management and consumer related issues, the Lund International Food Studies, LIFS, acts as an important network for those researchers engaged in the field of food (presented in Chapter 7).

FOOD INNOVATION CENTRES AND NETWORK ORGANISATIONS

It is the goal of many networks and organisations in the region to bridge the gap between the academic world, industry and public authorities, in order to create added value as well as innovative environments for people and their ideas, products and concepts related to food. All centres and networks presented here have a multidisciplinary approach and focus on more than one area within the food sector (often covering the entire food chain).

At a regional level, *Øresund Food*, as part of Øresund Science Region and the Øresund University, is a Danish-Swedish network bringing research, business and public authorities

together on both sides of Øresund. Øresund Food initiates and participates in triple-helix projects, meetings, seminars and conferences, with the aim of increasing the collaboration between Denmark and Sweden. The organisation's three main focus areas—production and sustainability; food and health; and gastronomy and sensation—aim to cover the entire food value chain. Since its establishment in 1999, Øresund Food has been directly involved in 27 projects with a total value of more than 25 million Euros. The largest current project is "Healthy Growth", focusing on nutrition and food ingredients. The project runs from 2008 to 2011 with a total budget of 2.1 million Euros. Øresund Food also initiates and participates in both Danish and international projects with mainly European partners. Together with seven other European regions, Øresund Food has, for example, established the Food Innovation Network Europe (FINE), with the purpose of developing strategies and tools for increased food-related investments in the region. Together with, among others, Skåne Food Innovation Network, Øresund Food also participates in the Baltic Sea Region project baltfood that provides support for SME's within trend spotting and transformation of research into marketable products.

Green Center is a research and development centre that works within the agriculture and the food industry. It is attached to Region Zealand County district, but it is an independent institution and has 12 employees. The centre has a modern laboratory, which offers biological, plant technological and environmental analyses and development assignments for different players. It hosts the secretariat of a coordinating network for food-related companies and institutions in Region Zealand County. The network is a three-year project running until the end of 2010, financed by European structural funds (through Vækstforum Zealand) and Region Zealand County.

VIFFOS is a Danish national centre for food and health focusing on establishing contact and knowledge exchange between food-related education and the surrounding world. The purpose is to secure healthy food at large-scale kitchens and at the same time to give students access to practical experience outside educational institutions. The centre is located in Roskilde and has 14 employees.

The Institute for Food Studies and Agroindustrial Development (IFAU) is a private, non-profit, independent research institution founded in 1982. Its objective is to support the development of Danish agriculture and food production through research and dissemination of information. It works based on a membership organisation structure and has published around 60 reports on various economical, social and technological aspects of the Danish and international food sectors.

BioLogue, located at University of Copenhagen, is a knowledge-based network for medicines R&D, with the aim of strengthening and supporting biomedical research and development as well as education at the universities, at hospitals and within industry. The network consists of representatives from all these partners as well as from governmental and regulatory partners. (In the spring of 2010, BioLogue and Biosys were fused and now have the name *BioPeople*. The network's aim is very similar to BioLogue's).

Medicon Valley Alliance, an organisation that promotes triple-helix cooperation and knowledge exchange in the Øresund Region within medical science, has initiated a project on diabetes that includes food and health aspects. The project, which is called Øresund Diabetes Academy, aims to create regional partnerships in order to improve research, development and treatment in the field of diabetes.

Skåne Food Innovation Network is located on the Swedish side of the Øresund Region and aims at developing the area of food in the south of Sweden. Members of the network are companies, organisations, public partners and universities, representing the whole food chain. Their biggest project Innovation at Interfaces (or Food Academy Innovation), started in 2004, is a 10-year initiative financed by Vinnova with co-financing from companies, universities, Region Skåne and the Skåne County Council. The value of these investments corresponds to at least SEK 200 million over a 10-year period. More than 100 projects of various sizes have been active during the period from 2004 until 2008. About 150 companies and 100 researchers, professors, post-docs, PhD students and students have been participating in the projects.

The Food Research Network, operated by the Skåne Food Innovation Network, has over 100 members, and represents academia as well as industry and public authorities. The network arranges meetings and seminars and provides a platform for multidisciplinary contacts.

Ideon Agro Food started in Lund in the mid 1980s as a network organisation aimed at strengthening cooperation between companies and researchers in the innovation process, including developing new techniques, new products, concepts or new ways of cooperating. Ideon Agro Food is a representative for stakeholders within the whole food chain, from soil to consumer and back to soil again. The purpose has been to build long lasting networks between companies and researchers that will improve the possibility for companies to use new knowledge, as well as for researchers to find new markets for their research results. Ideon Agro Food has worked on a consultancy basis since mid-2009.

Omvärld Alnarp, connected to The Swedish University of Agricultural Science (SLU) in Alnarp, Skåne, offers a platform for universities as well as industry to create new ways of cooperating and to facilitate collaboration between SLU and private and public stakeholders. Within Omvärld Alnarp, there are several main activity areas, among others Partnerskap Alnarp (also mentioned earlier in the report). One project worth mentioning is SPA (Svensk Potatisforskning Alnarp, or Swedish Potato Research Alnarp), with a special focus on potatoes. The project is part of Partnerskap Alnarp and they initiate as well as finance research and information projects focusing on potatoes, and with a specialisation on production, quality and environmental issues.

Nordic Innovation Centre (NICe), though physically located in Oslo, Norway, involves all Nordic countries in initiating and financing projects that stimulate innovation within various areas and cooperation between industry, public authorities and academia. New Nordic Food, healthy choices, functional food and food safety are examples of their focus areas. NICe is governed by the Nordic Council of Ministers.

COMMERCIALISATION OF RESEARCH

Food innovation and commercialisation of research ideas is supported by different stakeholders in the Øresund Region who are specialized in the area. In this part, Tech Transfer Offices (TTO) and other innovation-supportive organisations, as well as Science parks and incubators – platforms for innovative ideas to grow – are presented.

TECH TRANSFER OFFICES AND OTHER INNOVATION-SUPPORTIVE ORGANISATIONS

The main organisation within the University of Lund that helps researchers commercialise

their research results is *LU Innovation*, situated at Ideon Science Park, Lund. LU Innovation is the TTO of the University of Lund and is a partner in discussions about innovative ideas that bridge research/science and industry together. LU Innovation has helped a total number of about 50 companies in their early stages. Their financial partners are the University of Lund Holding Company (LUAB), LU Bio Science/Bioaccelerator, LU Food Science, LU CleanTech, Connect Skåne and Innovationsbron.

Besides being a financial part to LU Innovation, *LUAB* handles and supports the later parts of the commercialisation process. LUAB is financed by Sparbanksstiftelsen Skåne and Sparbanksstiftelsen Färs och Frosta and is 100% owned by the University of Lund. LUAB also has a number of so-called portfolio companies; *Thylabisco and Venture* are two examples within the food sector. Thylabisco was established in 2007 as an incubator company at Ideon Innovation by Per-Åke Albertsson and Charlotte Erlanson-Albertsson, with a background in biochemistry, medical and physiological chemistry at the University of Lund. Thylabisco is extracting a specific component from green leafs (mostly spinach), which is claimed to delay digestion, increase saturation, and thereby prevent obesity.

LU Development is a subsidiary company to LUAB that aims to act in the commercialising phase and focus on new innovations, as well as build a strong capital base for three thematic risk capital companies: *LU BioScience* (food and medicine), *LU FoodScience* (food and health) and *LU CleanTech* (energy, climate and environment).

Innovationsbron Syd AB was established in 2005 (formerly *Teknikbrostiftelsen*) by the Swedish government in collaboration with *Teknikbrostiftelserna* and *Industrifonden*. The primary aim of Innovationsbron is to support researchers, entrepreneurs and innovators in commercialising their ideas. Innovationsbron AB will spend 200 million SEK annually for the development of knowledge-based innovation and corporations in their early stages. VINNOVA is financing the cooperation as well, with the purpose of developing incubators. The incubator programme of Innovationsbron Syd is called IBIP and Ideon Innovation, Ideon Bioincubator and MINC are among the members. After a re-organization in 2008, Innovationsbron has had activity within five subsidiary companies, among others *Teknopol AB*. Teknopol AB offers business support to projects and companies in areas including CleanTech, ICT, Life Science, BioTech and Food Science. Teknopol is owned by Innovationsbron Syd, Region Skåne and ALMI Skåne and has universities, incubators and industry (and other stakeholders in the innovation system in the south of Sweden) as cooperation partners.

At the Swedish University of Agricultural Sciences, *Alnarp Innovation* aims at creating new knowledge and discusses ideas that can lead to commercial products and services. They offer a platform for universities and industry to exchange ideas and to be innovative.

Connect Skåne is another network with the aim at facilitating innovative companies and their ideas. They consist of approximately 80 companies and a number of public actors, among others the University of Lund, and about 100 individual members.

At Kristianstad University, *Futurum Creative Centre* helps and inspires students to develop their innovative ideas and projects. Högskolan Kristianstad Holding AB is helping students as well as researchers to commercialise their ideas and innovations.

Connected to the *University of Copenhagen*, Denmark, the *Tech Transfer Office* is responsible for the commercialisation as well as the protection of research ideas and results from the university. At the TTO, industrial as well as scientific and legal experts with special competencies within the field are connected.

The *Department for Research and Innovation* at the *Technical University of Denmark (DTU)* handles tech-transfer activities at the university and they also take an active part in all stages of the commercialisation process.

SCIENCE PARKS AND INCUBATORS – PLATFORMS FOR INNOVATIVE IDEAS TO GROW

In the Øresund Region, there are a number of science parks and incubators, creating innovative environments for entrepreneurs in their start-up phase in commercialising their ideas.

On Zealand in Denmark there are at least four science parks with primary focus on high-tech innovations, biotechnology and life science. *Symbion* is the largest science park in Denmark and functions as a meeting place for business, enterprises and universities. The science park focuses on high-tech innovators and innovation products within biotechnology and medicine, for example. Another science park also dedicated to biotechnology is *Copenhagen Bio Science Park (COBIS).* COBIS create growth conditions for ideas and innovative projects and they also offer an incubator environment for new and innovative life-science companies. Located close to the Technical University of Denmark, *ScionDTU* is the largest university-based science park in Denmark. They help in the innovation process and support companies in commercialising their ideas. In Roskilde, the *Research Park CAT* functions as an environment promoting innovation as well as a research park and a venture company.

In Skåne, there are five main incubators relevant for new food innovative companies, often connected to a science park: *Ideon Innovation, Ideon Bioincubator, Venture Lab, Medeon and Malmö Incubator MINC.*

Ideon Science Park, located in Lund, has two incubators: *Ideon Innovation* and *Ideon Bioincubator* (formerly Lund Bioincubator), where the latter specialises in life science companies. Together with the other incubators in the region, they create one of the strongest incubator clusters in Europe. The two incubators are hosting at least three companies related to food: *ARC Aroma Pure, Eaz pac AB* and *Membrayner.*

Sweden CleanTech Incubators (SCTI) and the *CleanTech Inn Sweden* act with the purpose of supporting newly formed companies and spinouts whose business concepts contribute to a sustainable society. Primarily they provide a virtual incubator service and are to be seen as a supplement to a local incubator programme by adding a CleanTech focus and knowledge to the business development. Both projects are operated by Teknopol AB, and are primarily working with projects related to food and life science (BioTech). SCTI, which is the regional initiative, is financed by Region Skåne, Innovationsbron and EU's structural fond. CleanTech Inn Sweden, which is a national project, is financed by Vinnova through Innovationsbron.

VentureLab started in 2001 and is a part of the University of Lund. It focuses on stimulating entrepreneurship among students and newly examined students who are planning to start their own business. VentureLab offers counselling, lessons and seminars and an office free of

charge for one year at their incubator site at Ideon. An example of one of these companies is *Eco Food Scandinavia AB*, which aims to offer people ecological food produced with environmental responsibility.

Krinova Science Park in Kristianstad was established in 1989 with inspiration from Ideon Science Park in Lund, as a result of a great interest from the municipality. There are three arenas at Krinova, where one is related to food. In 2009, seven different projects were related to food.

Medeon is another science park, located in Malmö, which also offers an incubator for knowledge-intensive companies within life science (pharmaceuticals, medical technology, biotechnology and healthcare). Two companies worth mentioning are *Akloma Bioscience AB,* which develops quality-improving molecular technologies for the food processing and medical industries, and *Prenet*, which works with dietary counselling and weight loss.

Malmö Incubator (MINC), also located in Malmö, started its activities in 2003 and is today a platform for innovative and growing companies. The well-known project *Lifebox*, with the aim of delivering good and healthy ready-to-eat-meals, was earlier a MINC company. A new incubator company called *Foodism* is on its way in MINC, with ideas about how to communicate brands with the help of flavours.

12. CONCLUSION

This report shows that the full food value chain is represented in research and education in the Øresund Region, even though the various aspects are not equally important. Also, the report shows the large diversity of ongoing research and education activity in relation to food in the Øresund region. The difficulties experienced in collecting information from the universities and university colleges made is impossible to quantify the area fully, but the report can be regarded as a large step towards a complete survey of all ongoing research and education activity related to food at the universities in the Øresund region. This study also indicates that only little cooperation between Danish and Swedish universities takes place in a formalized way when it comes to studies, namely within dairy technology between KU LIFE and LTH, thereby leaving room for improvement.

To conclude on the value chain step by step the following has been observed.

- A good deal of focus is placed on studies and research in agriculture and environmental aspects. This said, the picture is not complete as other areas of Denmark contribute importantly to the research and study of agriculture, environment, crop handling, etc.
- Within food technology, some weight is put on biotechnology and food safety, but food production seems to be a less highly prioritized area, especially at the Danish universities, where only one research and education centre is focusing on food technology, and one course on dairy technology is offered. The picture grows more complete when the Swedish institutions are taken into account, as both SLU Alnarp and LTH offer studies and carry out research in food production.
- When it comes to nutrition and health, a broad variety of studies and research is represented in the Øresund Region, seafood and aquatic products being supported mainly in Danish institutions.
- Courses and research in packaging logistics, development and design are a priority in some Swedish institutions but not in the Danish. Packaging development and design is not a research area in Denmark, but rather resides in the periphery of other research in different departments such as materials and biochemistry.
- Research within economy, management, innovation and marketing with some relevance for food is conducted on both sides of Øresund at DTU Management, Copenhagen Business School and the University of Lund. The multidisciplinary field of food and meal services is dealt with outside the Øresund Region in other institutions in Denmark. Food- and Service Management education is offered at the University Campus Helsingborg.
- Food and meals from social, cultural and pedagogical perspectives are often neglected when observing food-related studies and research but, in fact, we have located seven institutions that conduct research and at least two that offer courses on one or more of the themes on both sides of Øresund.
- Within the field of gastronomy, several courses are offered in the Øresund region, and research on molecular gastronomy takes place at KU LIFE, tying up the sack of the studies and courses from farm to fork.

In short, research and education is done along the whole value chain within the Øresund Region, and plenty of interdisciplinary activity is taking place. However, not all areas are equally well covered, and production improvement and packaging science are less in focus, while agriculture and food and health are relatively well represented. It also seems that the region has a broad variety of complementary players on the vast spectrum of food research and education. These are mainly public, but also private institutions on both sides of Øresund support the area of food.

13. HOW TO CONTINUE

The idea of the two reports of "Redefining the food sector in the Øresund Region" was to create an overview of the food sector in the Øresund Region for marketing and benchmarking purposes. We are pleased that the mission of looking into research, education and collaboration in the Øresund Region along the full food value chain has been accomplished. We are equally satisfied that the result of this second part of the report shows that there is vast research being performed and relevant educations being offered in the Øresund Region related to many aspects of food. Yet, at the same time, we recognize that for marketing the region internationally, it would be an advantage to also have completed the quantification initiated in this study, so that we could get a more thorough overview of the number of students, researchers, projects, collaborations and supportive organisations present in the region.

A well-defined framework is needed to quantitatively map and compare different regions in future studies. Based on our experiences with data collection for this report, we suggest further development of our data collection framework. If the framework is well defined and well structured, it will be possible to obtain valid data for different regions around the world that can be used for international comparison. Especially if this mapping is done on a regular basis!

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