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Indicators for sustainable food sales

A case study developing a climate indicator for Swedish food retailing

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Filip Danielsson

Department of Space, Earth, and the Environment
CHALMERS UNIVERSITY OF TECHNOLOGY
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Supervisor: Jörgen Larsson, Physical Resource Theory
Examiner: Christel Cederberg, Physical Resource Theory

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Department of Space, Earth, and the Environment
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Chalmers University of Technology
SE-412 96 Gothenburg
Telephone +46 31 772 1000

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Abstract

The food supply chain stands for approximately 20-30 % of global anthropogenic greenhouse gas emissions. It also contributes to a number of other sustainability problems. Research has suggested that the retailer has a unique position to push for a more sustainable food system. However, reporting and goal-tracking of retailers is inconsistent and lack clarity. This thesis suggests using sustainability indicators for retailer's food sales to improve their performance. The thesis uses climate change as sustainability aspect.

An indicator design methodology is used to create indicators. Three data sets are used in the design process. The indicator unit is suggested as *kg* CO_2*-eq per SEK in purchase cost*, and the indicator is based on Swedish food retailer ICA and their purchase data.

The indicator unit is applied in three versions of an indicator; high climate impact foodstuffs, red meat and dairy, and animal products. The intensities used to produce the indicators are compared between the intensities produced by this thesis and intensities from previous research.

In essence, the results show that some sort of device for goal-tracking and benchmarking is needed, and that indicators for food sales can be useful as that device. The results also discuss the possibilities of using other sustainability aspects, other than climate change. It also presents ideas about future uses of the indicators, as internal standards or regulation.

Keywords: sustainability indicator, food retailing, ICA, climate change, Scope 3, climate intensity, regulation, internal standard.

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1
Introduction

In the era of climate change, anthropogenic activity is disturbing the Earth system to an extent never seen before. Among the larger sectors that is affecting the climate, the food sector is a major contributor. Of all anthropogenic greenhouse gas (GHG) emissions, the food system stands for 20-30 % [4]. The food system also contributes to other areas of concern, such as land use change, loss of biodiversity, and use of chemicals (including agrochemicals and veterinary antibiotics), as well as other aspects connected to social and economic sustainability [5]. As such, improving the environmental performance of the food system is vital to combat a plethora of environmental challenges. An issue that arises, however, is the complexity of the food system. The supply chain of the food system is long, beginning with agriculture and furthering along to retailers and consumers.

Previous research has explored the different actors in the food system, to pinpoint where and what change is needed for a sustainable food system. Some research has suggested food retailers as a point of entry, as retailers' place in the food supply chain bridges the gap between suppliers and consumers [6]. As such, the position of retailers is one-of-a-kind, in that retailers can steer both consumption and production [5]. Despite this important role, retailers are not as heavily explored as other parts of the supply chain [7].

Other sectors, such as the automotive sector have clear guidelines and regulations on how the sustainability of sold products must improve. Among these standards, CAFE and the Post-2020 EU standard are noteworthy as they, albeit nationally or regionally, provide distinct allowed levels of GHG-emissions for personal cars and small trucks [8, 9]. These types of internal sector-wide standards exist in the food supply chain as well, but are largely centered around agriculture. Among these the EU nitrate standard can be mentioned [10]. This thesis explores the possibilities to apply sustainability indicators for sold product in the food sector, mainly as a tool for internal work but it is also discussed as a public policy.

One of the issues with benchmarking retailers as actors of change in the food supply chain is that there is no consensus in sustainability practices for food retailers [11]. Commonly, food retailers work with *in situ* activities, such as choice of coolant in fridges and using clean energy in stores [5]. The focus of the sustainability on the sold products is often put on consumers. For example, Swedish food retailer ICA uses an online tool called *Mitt Klimatmål*, which allows customers to track the GHG emissions of products bought at the ICA stores [12]. While this sort of indicator certainly provides interesting data for costumers, earlier parts of the retailer's role in the food supply chain are likely to have a larger potential for creating change. In essence, indicators for measuring the impact of products *de facto* purchased by the retailer from suppliers are largely unheard of. Instead, measures are often targeted at customers, such as with *Mitt Klimatmål*. If the activities of the retailer, purchasing products from suppliers and selling these products to consumers, and the role of the retailer is to bridge the gap, both roles of the retailer needs to be evaluated. Thus, indicators relating to the foodstuffs purchased by retailers need clarity, if the retailer want to measure their sustainability adequately.

1.1 Aim & research questions

The overall aim of this Master Thesis is to explore a new mode of measuring and benchmarking the sustainability of food sales. This new method is focusing on the food basket, and the retailer's role in the food supply chain. The method is applied on the Swedish food retailer ICA, and is based on their purchase costs.

With the aim in mind, the Master Thesis explores the following following questions:

- How can sustainability indicators for food sales be designed?
- What can be learnt from an attempt in calculating a climate indicator for food sales?
- What sustainability aspects, other than GHG emissions, can be measured through indicators for food sales?

2

Background and previous research

This section aims to provide necessary knowledge and background information. The section provides information on food retailing in the food system, the Swedish retailer ICA, and an overview of literature on indicator design.

2.1 Food retailing in the food system

The food supply chain has multiple levels of actors or stages, between which, upstream and downstream, economic goods related to foodstuffs flow [13]. Various models of how the system is constructed have been produced. The food supply chain is, in fact, highly complex and interconnected [13], thus the model presented in Figure 2.1 can be considered simple and linear. Due to new production methods and consumption patterns, concerns with sustainability, and globalization contributes to this complexity and dynamism, making the food supply chain more difficult to survey [14, 15].

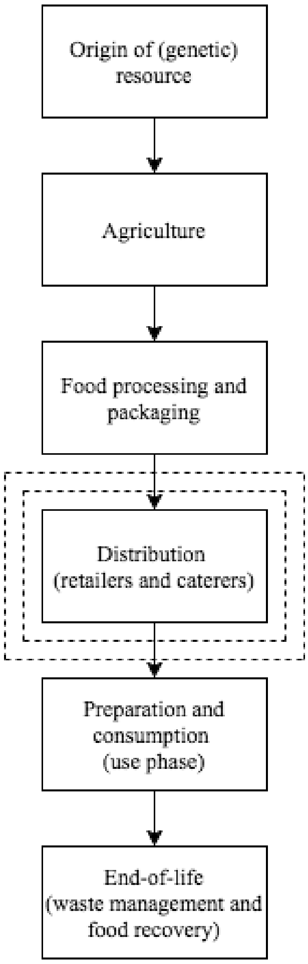

Figure 2.1: A simplified, linear model of the food supply chain [1].

The stages in the supply chain can be described in short as: acquisition of raw materials (origin of resource); farming (agriculture); conversion of foodstuffs (food processing and packaging); retailing, wholesaling and catering (distribution); storage, cooking, and eating (preparation and consumption); and food recovery, composting, bio-gas production, landfilling, and incineration (EoL management) [1].

The role of retailers, marked with dashed lines in Figure 2.1, in the food supply chain is the focus of this thesis. Albeit only a single part of the food supply chain, food retailers have been identified as having a unique power to nudge the food system towards more sustainable practices [15]. Examining the supply chain as a three step process consisting of a production-, distribution-, and use/waste-phase, retailers are placed in a prime position to influence both upstream and downstream activities [16]. As will be mentioned in Section 2.1.3, assessing and mapping these types of activities and their subsequent emissions are mandatory in reporting. Moreover, bridging the gap between production and consumer creates opportunity for regulatory action in the supply chain [17]. Downstream activities, more precisely consumption activities, can be influenced by retailers [18], via choice of products available to consumers [19], how distribution is operating [16, 19], and packaging choices [16, 19], as well as the choice of what stores to display in stores, product price setting, and what products to include in campaigns. Affecting the upstream activities, mainly the suppliers, is also possible for the retailers by influencing, for example, suppliers via supply contracts [16].

2.1.1 Sustainability in food retailing

Food retailers are one of the main distributors of food, together with caterers, wholesalers, and other types of distribution such as restaurants and cafés [11]. Overall, retailers are moving towards more sustainable practices according to their own reporting, e.g. British retailers [20]. This reporting covers a large range of different issues, such as health and nutrition, and climate change. However, there is little consistency in reporting, and most of the sustainability targets are either not clearly stated or completely missing [20]. Nonetheless, these sustainability practices and their targets encompasses many aspects of sustainability, with regard to the triple bottom line (TBL), i.e. environmental, social, and economic sustainability. Due to the complexity of the aspects of sustainable development, many venues for sustainable practices have been explored, such as pollution, labour standards, and waste issues [21].

Generally, focus on in-house activities, such as energy usage and choice of coolants, have been in focus [5]. These activities, with the retailing company as a focal point, only stand for a small part of the food system. Focus on indirect impact have been, at large, left outside the scope of the retailers. However, retailers in Sweden have in recent years started to promote eco-labelled products, fair-trade products, and origin-labelled products to reduce indirect climate impacts. It is only recently that the scope of retailers have expanded, mostly due to public opinion. Including upstream and downstream unsustainable activities in the retailers operations have increased greatly [22].

2.1.2 UK and Swedish retailers

The usage of indicators or similar measures to track sustainability performance of retailers is sparse. In the UK, however, programs have been launched to force retailers to act more sustainable. Especially larger retailers are showing increased interest in sustainability reporting, mainly in reporting towards stakeholders. However, most reporting is problematic in many ways. Most sustainability work is solely in-house activities, relating to energy use, and little has been done outside of the company [19]. Furthermore, retailers are targeting customers to better sustainability performance. An example of this is the program launched by Swedish retailer ICA, *Mitt Klimatmål*. In the UK, retailers have begun to produce separate environmental reports, as well as investigating the impacts of product life cycles [19]. Recycling programs have also been put into place [22].

In essence, the sustainability work of retailers suffers the same problems world-wide, as stated by the organization *The Food Foundation* in their Plating Up Progress reports. Reporting and measuring is very inconsistent [20]. While most larger retailers, especially in the UK, have set targets for their sustainability work, few updates are made on how these targets are met. Examining nutrition, for example, no actual shifts in product promotion can be seen in UK retailers [20]. Targets are also lacking in Scope 3 emission reporting [20]. Nevertheless, an interest is shown by retailers in both the UK and Sweden. Concisely, the retailer's in the UK (as well as the caterers and restaurants) have inconsistent reporting on most aspects of sustainability. This could be seen especially for the most important topics identified. In more recent time, the UK have suggested creating key figures for the amount of turnover from meat, as well as non-nutritional products [23]. These suggestion fall in line with the proposed indicator type that is suggested in this thesis.

2.1.3 GHG Protocol

To combat climate change, it has generally been established that legislation and governmental intervention will not be enough to meet set targets for allowable GHG-emissions [2]. The role of other actors, such as businesses, is thus of importance. One way to develop an overall standard for GHG accounting throughout the supply chain is the GHG Protocol, which identifies three scopes that companies are to report (ibid.). Scope 1 aims to account for reporting of direct GHG-emissions, Scope 2 aims to account for reporting of indirect GHG-emissions related to energy usage. Scope 3 accounts for indirect upstream and downstream GHG-emissions that are not covered by Scope 2, in a cradle-to-grave manner [24]. The three scopes are presented in Figure 2.2. While Scope 1 and 2 reporting is mandatory for users of the standard, while Scope 3 reporting is optional, albeit accounting for the majority of GHG-emissions of a company [25].

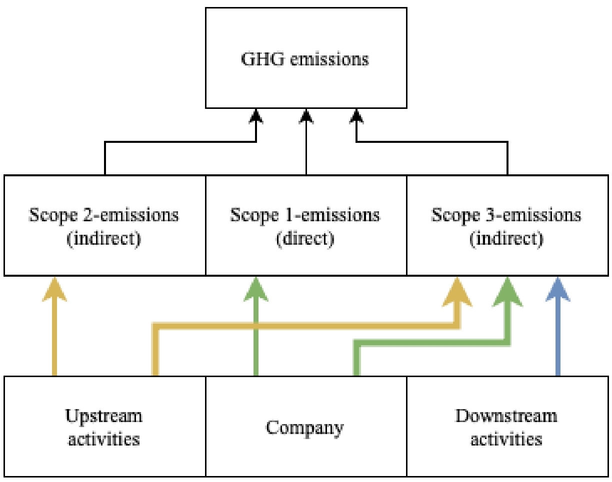

Figure 2.2: Overview of the scopes of the GHG Protocol [2].

Sustainable business management requires accounting for all GHG-emissions, to understand risks and opportunities in the supply chain, as well as providing information through public reporting [2]. Having an inventory of the Scope 3-emissions provides an opportunity for companies to better their sustainability performance. In the case of food retailers and foodstuffs, the downstream and upstream Scope

3-emissions are akin to the entirety of a foodstuffs' life cycle. The two steps in close proximity is the products being sold to costumers (downstream) and the products purchased from the suppliers (upstream), as well as any possible in store food waste [6].

According to the literature, retailers are proficient in measuring their Scope 1 and 2 emissions. However, Scope 3 reporting is lacking as knowledge of the indirect emissions throughout the supply chain is largely unknown [20]. This is partly due to retailers aiming at lowering emissions by working in-house [5]. However, suggestion on how retailers in Britain can work towards more complete Scope 3 reporting have appeared in literature [20].

2.1.4 Current use of indicators in food retailing

Designing indicators as the one explored in this thesis is not something that has been done extensively in the past. Apart from mapping out how food retailers are working with sustainability [5, 20], the literature on this kind of indicators is sparse. These types of mappings largely focus on problem areas for food retailers, and how sustainability issues tied to food production are reported. The consensus in literature has been that while retailers (as well as other distributors of food) report on a plethora of sustainability issues, the reporting is lacking and incomplete [20]. Sustainability goals are often set, such as decreasing GHG-emissions in operations, but little reporting on how to achieve these goals are present. Other sustainability issues have been identified as well, such as antimicrobial resistance and nutrition, but they suffer the same issue with reporting being inconsistent and that goal-setting is lacking clarity [20].

The environmental impact of food items has been heavily studied, mostly via different kinds of analyses for specific products or product types. These studies use life-cycle assessment (LCA), input-output assessment (IOA), or similar assessment tools to measure the impact of food items [26, 27]. The impacts often revolve around climate change, but other sustainability aspects such as land and water use are also prevalent. However, the measures produced by these studies cannot be considered indicators, but rather intensities.

The indicator explored in this Master Thesis is most similar to the results produced in the report *Analysis of the environmental impacts of 218 consumption items* [27]. The research paper uses two assessment tools (process analysis and IOA) to measure the climate impact of 218 products and services. Three measurements were produced, covering climate change ($kg\ CO_2\text{-}eq$), land use as agricultural land occupation (m^2), and water resources depletion (l) per SEK for each type of food. The intensities produced by the report are of interest for the calculation of the final indicator(s). Possibilities of this kind of indicator are, other than that, sparse.

2.2 ICA Gruppen and Mitt Klimatmål

ICA Gruppen is Sweden's leading food retailer, standing for approximately 52 % of the Swedish food sales [28]. The company's yearly turnover was 137 billion SEK in 2018. Due to the extent of ICA's market share in Swedish food retailing, the company exerts large influence on the Swedish food industry as a whole.

ICA's sustainability work is covered by four overarching sustainability goals, covering both ecological and social sustainability [29]. The goals cover human rights, quality control via putting pressure on suppliers, promoting nutritional products, and aiming for climate neutrality. The climate neutrality goal is supposed to be met by not only improving ICA's own operations, but also other actors in the supply chain. Other than the sustainability goals, ICA has launched the project *För en God Morgondag*, which is based on UN Global Sustainability Charter. *För en God Morgondag* is subdivided into five categories: local, environment, health, diversity, and quality. The project aims to contribute to the community in which it operates, lessen their climate impact (with strategies such as choice of coolants and energy sources in stores, and promoting sustainable product choices), promote healthy and nutritional diets and products, increase the diversity in the company, and secure the quality of products and operations [29].

As part of their sustainability work, ICA also launched the project *Mitt Klimatmål*, as a way of supporting costumers to track the climate impacts of their food consumption. *Mitt Klimatmål* is an online tool in which all products that costumers' with an ICA membership card are tracked. The customer can then use the online tool to see the climate impact of their purchases [12]. Each product purchased is tracked under both a broad category, such as Meat or Pantry, and subsequently divided into subcategories. In the meat category then, the climate impact of specifically pork and meat can be seen. The product categories are measured using *kg* CO_2*-eq per kg of food.* This gives the consumer information on the total emissions of their purchases, as well as information on the emissions of specific products. With this information, the consumer can compare their climate impact with the Swedish mean, individual development on a month to month to basis, as well as what would be required to meet the UN Climate goal 2030. Furthermore, the tool suggests other products to buy as substitutes to decrease the consumer's climate impact, produce that is in season, and climate-friendly recipes. It also tries to take into account other aspects of sustainability, by tracking the amount of purchased products that are ecological, and ethically and environmentally labelled [12].

The development of the tool was initiated through a collaboration with Chalmers, in a project named "One Tonne Life". "One Tonne Life" aimed to showcase how a lifestyle with emissions of only 1 tonne CO_2-eq per capita and year would resemble [30]. The project used Life Cycle Assessment (LCA) and Input Output Analysis (IOA) to quantify the climate impact of consumption. The climate data used in *Mitt Klimatmål* are based on two different sets of data: climate data from RISE [31] and a publication from SLU [32].

ICA made a press release recently, where the company's climate ambition intensified further, aiming to be climate neutral as well as halving the climate impact of customers by 50 % by 2030 (original wording in Swedish: "ICA vill halvera klimatpåverkan av kundernas livsmedelsinköp 2030. Inspirera och stötta kunder med olika sortimentsförflyttningar, minska matsvinn och förbättra produktionsmetoderna för en lägre miljö- och klimatpåverkan.") [33].

2.3 Indicators

When speaking of sustainability in business, there is a need for some way to find areas of unsustainability where work is needed. Using some sort of indicator helps supervising progress and problem areas in a practical manner [34]. Indicators are a prevailing way of measuring performance [35] and can be defined as a measure of information related to some sort of goal or performance [36]. It has been theorized that usage of indicators are of importance when working towards more sustainable business practices, and indicators has thus surfaced as the at hand practice in business [37, 34]. The areas of use for indicators in sustainable business practices are plenty such as goal setting to move towards more sustainable practices [36], providing necessary information on progress [38], assessing effectiveness of progress [39], communicate information to stakeholders [34], finding areas of concern [37], guide decision-making
It is, however, noteworthy that moving from traditional indicators to sustainability indicators (SI) is not as straightforward as it may seem. SI's can be defined as indicators that provides information on the three sustainability aspects (ecological, economic, and social) [40]. Traditional indicators are made to be compared to set targets, while SI set out to measure sustainable development, a process rather than a goal [38]. As such, SI are more useful in finding, in a certain set, where the system is lagging [39]. These lagging parts can more specifically be considered areas of unsustainability. Describing problem areas provide ample opportunity to improve the system as a whole, as the possible unsustainability of its constituents are known.

2.3.1 Designing indicators

With the concept of indicator being broad, using relevant indicators is essential to track progress or describe situations in an adequate way. Therefore, the design of indicators are a crucial part of their implementation [34]. Depending on the intended use of the indicator, as well as the environment in which it is to be used are important to take into account. While standardization of indicators are preferable, be it in a sectoral or sub-sectoral manner, this type of industry wide indicators are seldom as valuable as one could imagine [37]. More specific indicators used in a specific cases are of interest.

When designing indicators, the main question at hand is whether an indicator or a group of indicators embody what is supposed to measured [41]. Questions to keep in mind when designing indicators are as follows: its intended use, i.e. is it a measure of progress or a way of benchmarking the current situation [42]; what conditions does the indicators operate under [39]; and why the indicator is needed [34]. There is not one "best" design method, but the main consensus relies on various iterative processes [43]. In general, the various frameworks or step-by-step processes are done in the steps described in Table 2.1.

Table 2.1: General indicator design/selection process, modified from Fiksel et al [3]

Design/selection step	Description
1. Needs assessment	(Stakeholder) participation to evaluate areas that are in need of work or need to meet some target.
2. Issue selection	Narrowing the results of the first step, defining the issues more clearly.
3. Indicator design or selection	Design or selection of the indicator(s), either choosing from a set of existing indicators, or designing new indicators.
4. Adjusting and evaluating indicators	Adjusting indicators if the intended need was not satisfied. Evaluation of both process and end-goal.
5. Implementation of indicators	Putting the indicators into practice, to be used by decision-makers.

The starting point of the design/selection process is via some sort of stakeholder involvement, to assess the possible need for indicators [43]. Stakeholders can include a range of different actors, such as unions, environmental non-profit organizations, and industry associations. This is true for most indicator design frameworks, such as Sustainable Development Records (SDR) [36], Pressure-State-Response (PSR) [36], PICABUE [44], and Sustainability Performance Measures (SPM) process [3]. Involving stakeholders is usually done to answer a number of questions, most of which have already been touched upon. An indicator is pointless if there is no need for it, and the stakeholder involvement aims to reveal areas of concern [45]. How this involvement activity is performed is up to the company or organization, and can vary. Utilizing stakeholder competence and knowledge can shed light on stakeholder expectations, which in turn reveals what involved subjects sees as desirable or necessary. Seeing stakeholders as an important part of a business or organization, then it is important to meet these expectations. Stakeholder involvement can also reveal information that decision-makers either are not familiar with, or have not thought of themselves [43]. Therefore, the participation can clarify and identify issues that are in need of work, either from a business point of view or with regard to reputation. However, the results of this first step can oftentimes be considered broad, as it aims to identify many areas of concern, and need to further clarified [45]. The stakeholder involvement, assessing the need, is as mentioned apparent in many a framework, albeit under different names. For example, PICABUE uses the term "identification of issues" [44]. The design/selection process of established frameworks will be presented further on.

In general, the second part of the process is directly tied to the assessment of needs. When the needs of the company or organization has been discussed and established, the process needs to narrow the issues that are to be evaluated and measured, i.e. the most important aspects [3]. This part of the process can be summarized in two parts: establishing the specific issues/goals [3] and planning of the process [43]. Deciding on the specific objectives or issues means that the decision-makers need to make a judgement on what is of interest, often in collaboration with either experts or stakeholders [44]. There is no standardized way of conducting the issue selection. What issues to narrow in on is up to the company or organization, and has to be tailored to the needs and goals of the specific company or organization.

In the design/selection stage, the issues need to quantified, i.e. how are the indicator(s) going to be used to measure either performance or targets. The indicator(s) design/selection is once again dependent on what is relevant to the company or organization. Nevertheless, some reference points exist on what to take into consideration when designing or choosing indicators [43]. The indicator(s) should be comprehensive, controllable, cost-effective, manageable, meaningful, robust, and timely [3]. A large part of indicator design also consists of gathering appropriate data. The data gathering requires to be performed in a timely manner, especially if the indicator's intended use is anticipatory [44]. As the indicator relates to a specific issue, the indicator(s) need to be a measure that is connected to the specific issue. Selecting or designing the right indicator(s) for the right issue is thus of utmost importance. The first round of indicators should be seen as draft indicators [43]. These will be adjusted in subsequent steps, either to be better suited for the intended use, or to match expectations of decision-makers, users, and stakeholders.

The adjustment phase harks back to the first step, in that the indicator after design or selection requires evaluation. Adjusting the indicator(s) can be done either directly after the design/selection, via some sort of internal or external survey [44], or after testing [43]. The rationale behind direct evaluation is to review whether the designed/selected indicator(s) are appropriate for the intended use or goal. On the other hand, testing might first be required, especially if the indicator is intended to measure performance. How and when this part of the process takes place is both up to the decision-makers and the indicator itself. As mentioned previously, the intended use of the indicator can be what dictates the response time. Decision-makers can evaluate the indicator after testing, to determine the direction, pace, and overall development and its appropriateness in the organization and company [37].

After rigorous testing, adjusting, and evaluation the indicator(s) can be implemented into the daily practice of the company or organization [3]. Implementing the indicator, connecting to the intention of the indicator(s), can then over a longer period of time be measured and evaluated as part of the "day-to-day" business.

3
Methodology

The methodology section aims to explain data sources, design of the indicators, and limitations in the data.

3.1 Data sets

Two different data sets were used; one labelled 'economic and product weight data' and one labelled 'climate data'. Climate intensities, used in the calculation of the final indicator(s) are also presented briefly.

3.1.1 Economic and product weight data

The economic data was provided by the Swedish food retailer ICA. The data set contained all articles purchased by ICA Gruppen centrally over the period of one year (2019), which subsequently are sent to ICA's marketplaces: ICA Nära, ICA Kvantum, ICA Maxi, ICA Supermarket, ICA Online. Different articles are sent in different amounts to different marketplaces. The numerical information could be divided into two categories: 'weight data' and 'monetary data'. The 'weight data' was presented via the total sum of delivered quantity of packages and the weight of one delivered package. The 'monetary data' included the total sum of all articles purchased centrally. These two sets of numerical data formed the basis of the calculation of the indicators with regard to the economic data.

The economic data was based solely on one Swedish retailer, ICA. This, however, should not be of major concern in the coming section, describing the methodology. Albeit other retailers may present information in other fashions, as long as the total weight and total purchase cost of each article is known, the method is applicable. Due to a confidentiality agreement between ICA and the author, the values of the weights and purchase costs are not presented in the thesis.

3.1.2 Climate data

Before presenting the actual climate data, the selection of $kg\ CO_2\text{-}eq$ has to be explained. When measuring sustainability, a plethora of possible measures has to be considered. As is the case with food, the food industry contributes to many unsustainability aspects. Drawing on the triple-bottom line (TBL), some issues that can be mentioned are climate change, land use change, water use, biodiversity loss, and use of chemicals (e.g. pesticides and fertilizers), as well as other sustainability aspects connected to social and economic sustainability. The food supply chain also combats unique issues with food waste and antimicrobial resistance, as well as health and nutritional factors, to name a few.

The choice of focusing on climate change, i.e. GHG emissions, are plenty. Firstly, ICA's own goal of decreasing the climate impact of customer by 50 % by 2030, as mentioned previously. As the possibility of the indicators to be used as an internal indicator for ICA (or other Swedish food retailers) is to be evaluated in the thesis, this simplifies the process of both understanding and possible implementation in the future. Secondly, the food supply chain is one of the main contributors to global anthropogenic GHG emissions. Although these emissions can hardly be attributed solely to retailers, retailers position themselves in a unique role in the food supply chain. Linked to this, another issue that arises specifically for the food system is the large amounts of GHGs other than CO_2 that are emitted. While other industries with large contributions to global anthropogenic GHG emissions mainly emits CO_2, the food system contributes with large amounts of CH_4 and N_2O. Thirdly, data on the GHG emissions of food products is readily available, both globally and nationally. Having access to data on the climate impact of food products allows the scope of the thesis to solely focus on indicator design. The alternative of performing some sort of assessment to quantify other aspects of sustainability is outside the scope of this thesis. Fourthly, some food products can be labelled 'problem products'. Red meat, for example, contributes greatly to anthropogenic GHG emissions throughout its life cycle. As this problem is known, and different alternatives for regulating meat consumption are under discussion in research, choosing climate change as a measure falls in line with previous research. Fifthly, other sustainability aspects such as the loss of biodiversity, are improved when GHG emissions are lower, since climate change is one of the main drivers of biodiversity loss [46]. Therefore, various sustainability aspects are indirectly taken into account in the scope of climate change.

Other sustainability aspects, as those mentioned above, while falling outside the scope of the thesis are still of interest to take into some consideration. One main issue is the overall applicability and availability of other sustainability aspects. As an example with regard to the applicability, water use is highly interesting with regard to legumes, fruits, and to some extent terrestrial animal proteins. However, this is not the case for fish protein. With regard to data availability, the quantification of other sustainability aspects is up for debate. Metrics for measuring water use can be performed in many ways, and there is no single measure. Other sustainability aspects will be further discussed in later parts of the thesis, as a possible compliment or option other than GHG emissions.

The data set used for the climate data is based on research from Moberg et al [26]. The data produced from this article is based on the Life Cycle Assessments (LCA) methodology to determine carbon footprints of food products sold on the Swedish market. In the supplementary material of the article, $kg\ CO_2\text{-}eq$ per unit of measurement (either kg or liter of product) are presented in three variants: agricultural emissions only, emissions to farm-gate, and emissions to retail-gate. Because this thesis firstly examines the retailer, and the purchased products by the retailer, the latter emissions will be used. The data for emissions to the retail-gate includes the full cradle-to-retail gate emissions. Emissions in the article are aggregated based on emissions of CO_2, CH_4, N_2O, and HCFC-22 for fish and seafood. The data also takes into account country of origin and production system, as well as the average emissions of the products. Since the average data mirrors the market shares of the Swedish food market, the averages will be used in this thesis.

3.1.3 Intensities

As mentioned in Section 2.1.4, intensities for foodstuffs with regard to climate change have been produced previously [27]. These intensities use the unit *kg CO_2-eq per SEK*, and are thus similar to the intensities produced in this thesis. The intensities produced by Kanyama [27] are based on the Swedish market, and cover not only foodstuffs, but rather a range of products and services available on the Swedish market. As part of the calculation to obtain indicators, for which the unit will be further discussed, climate intensities are needed. While this thesis calculates ICA-specific intensities, these will be contrasted and compared to the intensities provided by Kanyama [27]. As the values of the intensities might differ, so would the values of the final indicator(s). Thus, the use of both the calculated intensities in the thesis and previously calculated intensities will give a better overview of possible indicator values.

3.2 Designing the indicator

The design process used the general indicator design process described in Section 2.3.1. In the design process, only step 1-3 (see Table 2.1) were performed. The model is further presented in Figure 3.1.

Adjusting and evaluating the indicator was not applicable in the design phase as such, and will rather be discussed in the end of the thesis. The implementation phase requires evaluation and adjusting and will not be covered in this thesis. This is shown with a dashed line in Figure 3.1. Below, each step of the design process will be described in detail. First, the needs assessment is described. In this section, the process of identifying the needs of Swedish retailer ICA is described. Secondly, the issue selection defines the issue at hand as well as what sustainability aspects that were included. Lastly, the design of the indicator is presented. This includes the data used, all choices made regarding the data, what is included and excluded, and the proposed way of calculating the indicator.

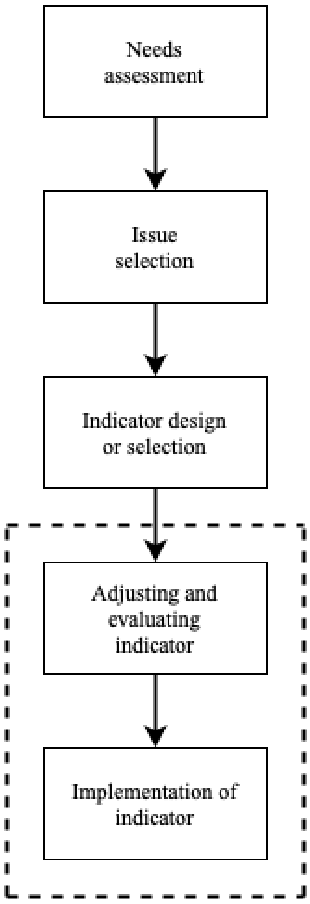

Figure 3.1: Flowchart showing the methodology steps, as described in Table 2.1.

3.2.1 Needs assessment

A traditional stakeholder process was not conducted, although it would have been preferred. The indicator itself was proposed to ICA by researchers within the research program MISTRA Sustainable Consumption (Jörgen Larsson), a program where ICA is a partner. ICA showed interest in exploring a new way to measure their own sustainability in the purchase phase, i.e. measuring the sustainability of the products purchased by ICA and distributed to their stores. This interest stemmed from a drive to increase the overall sustainability of ICA's operations. Measuring this phase of ICA's supply chain provides information upstream, and aids ICA in their overall sustainability work. With the information described in Section 2.1.3, acknowledging the upstream emissions is pivotal for a company or organization to better grasp their overall sustainability.

The overall need for ICA was to find a way to measure the sustainability of their purchases, similar to *Mitt Klimatmål*. The overall need for the thesis as a whole was to create an indicator that could be used in a similar fashion to that of the CAFE system used in the automotive industry.

3.2.2 Issue selection

Due to the difficulty in measuring sustainability, there needs to be a clear delimitation on what sustainability factors to measure and include. With regard to the food supply chain in general, and the food retailer in particular, a number of sustainability aspects were considered, such as GHG-emissions, land use, water use, and biodiversity. Preferably, using the triple bottom line, then economic, environmental, and social aspects should be included. However, the intended target of the indicator was not to be an overall sustainability indicator for purchases. Rather, the intended use was to measure some specific sustainability aspect of the purchases done by ICA (see Section 3.2.1). With *Mitt Klimatmål* and ICA's new climate goal as a reference point, the chosen sustainability aspect was global warming, expressed as kg carbon dioxide equivalents (kg CO_2-eq). This was also used in *Mitt Klimatmål*. Emissions of CO_2-eq also relates to a broad range of secondary environmental impacts, such as sea level rise, extreme weather, and food scarcity, but it is also one of main drivers behind biodiversity loss [46].

In essence, the issue selected was the sustainability of ICA's purchased products, with regard to global warming. The purchased products only took into account foodstuffs. The reasoning for this was that some foodstuffs, such as meat and dairy have very high climate intensities, based on the numbers in Kanyama et al [27]. Meanwhile, products that are not foodstuffs, and that are still a part of ICA's assortment (such as skincare and magazines) have much lower climate intensities. Foodstuffs in this thesis is defined as products consumed by humans as a part of the normal intake, or as an ingredient in a meal.

3.2.3 Indicator design

Below follows the general methodology, based on the information given above. The steps were an initial elimination of products that did not meet the definition of foodstuffs, an identification of food categories, an in-depth identification of relevant products, a summation of total weights and purchase costs, and the combining of the two data sets. Below, each step will be described in greater detail.

All products not considered foodstuffs were removed. This included, but was not limited to: beauty products, hair and body care, non-prescription drugs, tobacco (cigarettes and snus), food supplements (e.g. vitamins), chewing gum, paper (toilet paper and kitchen towels), textiles (e.g. towels and clothing), and cookware. Products that are technically foodstuffs, but might not be easily quantifiable or completely fits the definition, such as ready meals, children's food, and health food, remained. This first elimination shortened the total article list to about half of the original articles. Elimination was also done more in depth to avoid counting articles that were not foodstuffs. For example, coffee filter fall under the same category as ground coffee, but should not be considered foodstuffs.

In the second step, articles had to be categorized into more general food type categories. This meant performing a thorough analysis of the entire remaining data.

The food types were created from the data, meaning that ICA's own categorization was taken into account. However, some food types were part of more general categories. An important note to make is that specific types of products were not identified in this step. As an example, while several different types of meats and fruits are part of ICA's assortment, they were only categorized as fruits and meats. In this step, hard-to-define products were also eliminated. This was mainly done due to the scope of the study not being to calculate any climate impacts of foodstuffs. Thus, categories such as ready meals were also eliminated. Another reason for this elimination was also to maintain a focus on not only easily quantifiable products, but also to focus on high-impact products, such as meats.

After sorting articles into categories, the articles were further sorted as specific articles. In essence, this implied that the economic data had to be completely reviewed. No specific definition was given to each overarching category, and thus the categorization was done somewhat arbitrarily. However, the articles were categorized into the generally accepted overarching category. After the elimination, categorization, and identification, the products in Table A.1, in the Appendix were still considered.

As can be seen in the Appendix, 11 categories are presented, containing a total of 174 different sorts of products. No distinction was made with regard to different types of the same product. In essence, this means that, for example, a potato was just considered as potato, and not the different kinds of potato that exists in ICA's assortment.

Once the proper products were chosen, the numerical values of the products, with regard to weight and purchase cost had to be summarized for each product. Due to the confidentiality agreement between ICA and the author, this data cannot be shown in this thesis. The weights were calculated using the number of purchased packages and the total weight of one package. The value for each article of a specific product was the summarized to produce the total weight of that specific purchased product. The total purchase cost was produced by summation of the total purchase cost of a specific product. After conducting this step, the total weight, expressed in *kg of product*, and purchase cost, expressed in *million SEK*, was known for each of the products identified and presented in the Appendix.

The climate data was based on either weight or volume, expressed as *kg* CO_2*-eq per kg of product* or *kg* CO_2*-eq per liter of product.* For the case of this thesis, products that were measured in litres were not taken into account. Therefore, knowing the total weight of each specific product in ICA's assortment, the total purchase cost of said products, and the climate impact, a calculation could be performed for each product to produce intensities. The intensity calculation was performed using Equation 3.1,

$$I = (m_{tot} * C)/p_{tot} \tag{3.1}$$

where I denotes the intensity of a product expressed in *kg* CO_2*-eq per SEK*, m_{tot} denotes the total weight of a specific product expressed in *kg*, C denotes the climate parameter expressed in *kg CO_2-eq per kg of product*, and p_{tot} denotes the total purchase cost of a specific product expressed in *SEK*. Using the measurement suggested in this thesis, the discrepancy between larger and smaller stores can therefore be proportionate to the size of the store. While the climate impact variable is unchanged, the important factors are the amount of purchased products and the purchase costs (see Equation 3.2). If a larger store purchases more product, the other variables increase. It is therefore possible to compare different store in a proportionate fashion. What the retailer decides to use the indicators for is, in the end, up to the retailer. If the retailer is interested in comparing stores for reasons unknown, there is a possibility to do so. The indicators, and the method, are versatile. Another reasoning for choosing the suggested unit was to further focus on earlier parts of the supply chain, as the denominator is intended to relate to purchase costs. This shifts the focus from the normal consumer-focus (as ICA does today), to a production-focus, where most of the emissions in the supply chain take place.

The final indicator is calculated using Equation 3.2,

$$CI = \Sigma(I * p_{tot})/P \tag{3.2}$$

where CI denotes the final climate indicator expressed in *kg CO_2-eq per SEK*, I denotes the intensity of a product expressed in *kg CO_2-eq per SEK*, p_{tot} denotes the total purchase cost of all products over a period of one year *SEK*, and P denotes the total purchase cost of all foodstuff expressed in *SEK*.

3.3 Comprehensive list of limitations in data processing

Due to the extensiveness of the economic data provided by ICA, the data processing proved to be cumbersome. The climate data was also not extensive enough to take into account all types of products. Below follows a list of limitations:

- Only foodstuffs were considered. As the data contained all products purchased by ICA, whatever type of product, the non-foodstuff products had to be eliminated. This was done by hand.

- The climate data could not be used to create a product specific indicator for certain types of products, e.g. products containing a mix of ingredients like ready-made meals.

- The data provided by ICA and the data in [26] were not completely compatible. The data provided in Moberg et al [26] did not cover all product categories that could be defined in ICA's data, such as mushrooms.

- The data could not be presented in detail in this thesis. This is due to a confidentiality agreement between ICA and the author.

- The methodology focuses on two main types of foodstuffs: foodstuff that is easily quantified (i.e. "pure products") and high-impact food (such as meat and some legumes and fruits). This is due to the limited time, the extensiveness of the data, and the intended purpose of indicators such as this (see design method in Figure 3.1).

4 Results

This section presents two results. Firstly, the calculated intensities (in *kg* CO_2 *per SEK*), based on the economic and product weight data from ICA, and the climate data from [26]. Secondly, a few suggestion indicators are presented, produced using the suggested methodology. These indicators are based on both the intensities produced in this thesis, and the intensities produced by Kanyama et al [27].

4.1 Climate intensities

Using the suggested design method presented in Section 3.2.3 and the gathered and adjusted data, Table 4.1 shows the produced intensities. The intensities are based on purchased goods by ICA during the period of one year (2019) for all marketplaces.

Table 4.1: Product climate intensities

Category	Product	Intensity (kg CO2-eq/SEK)
Root vegetable	Carrot	0.032
	Potato	0.041
Legumes	Avocado	0.024
	Bell pepper	0.071
	Broccoli	0.031
	Cabbage	0.042
	Cauliflower	0.026
	Cucumber	0.030
	Lettuce	0.011
	Pea	0.023
	Tomato	0.067
Berries	Raspberry	0.013
	Strawberry	0.018
Onions	Leek	0.024
	Yellow onion	0.046
Fruits	Apple	0.014
	Banana	0.064
	Kiwi	0.024
	Orange	0.069
	Pear	0.030

Table 4.1: Product climate intensities

Category	Product	Intensity (kg CO2-eq/SEK)
Meats	Beef	0.171
	Pork	0.081
	Poultry	0.068
Fish and shellfish	Cod	0.076*
	Herring	0.033
	Mackerel	0.021
	Plaice	0.263*
	Roe	0.037
	Salmon	0.047
	Shrimp	0.144
Processed products	Bread	0.037
	Margarine	0.066
	Pasta	0.152
Food grains	Rice	0.201
Dairy, cheese, and egg	Butter	0.233
	Cheese	0.251
	Cream	0.198
	Crème fraîche	0.158
	Egg	0.099
	Milk	0.020
	Yoghurt	0.106

A note to make about the results is the discrepancy between listed products in the Appendix and the products with calculated intensities presented in Table 4.1. This is due to the data available in the climate data, which did not cover all identified products. While 174 products were identified initially, 41 had data available to create intensities, and are marked in bold. Comments on this will be provided in later sections. Table 4.1 shows the 41 different products, divided in categories, and the intensity values.

4.2 Exploration of different climate indicators

Using Equation 3.2, a few alternatives were calculated to showcase how the indicators may be designed depending on what the recipient intends to do with the indicator. There are different ways of presenting climate indicators. A set of indicators based on the suggested unit (*kg* CO_2 *per SEK*) are presented with different examples of what product categories to include. Other indicators, not taking into account climate but some other sustainability aspect could also be of interest. However, as stated previously in the thesis, these will not be presented here. That type of indicator will be explored in the subsequent section. Nonetheless, using another sustainability aspect other than climate are important for a number of reasons. For example, the food industry faces a plethora of sustainability issues other than climate change.

Three examples were provided using the intensities presented in Table 4.1, and compared with intensities from Kanyama [27]: high-impact foodstuff (Section 4.2.1), red meat and dairy (Section 4.2.2), and animal products (Section 4.2.3).

4.2.1 High climate impact foodstuffs

The indicators presented in this section are based on high-impacting foods. The 20 products with the highest intensities in Table 4.1 was included. As a comparison, the same claculation for these 20 products was done using the product climate intensities from Kanyama [27]. The intensities between the two sets differ slightly, and are produced using different methods, which is why comparison is of interest.

The products included were tomato, bell pepper, banana, orange, pork, beef, poultry, salmon, cod, shrimp, plaice, pasta, margarine, rice, butter, yoghurt, cream, hard cheese, crème fraîche, and egg. The number of products that were included was arbitrary, and the number of products can be increased or decreased. The choice of 20 products was done to give an idea as to how the indicator might appear.

Using Equation 3.2, two indicators were produced. Based on the intensities in Table 4.1, the final indicator was 0.155 $kg\ CO_2\text{-}eq\ per\ SEK$. Comparatively, using intensities based on ([27]) the indicator value was 0.140 $kg\ CO_2\text{-}eq\ per\ SEK$. Comparing the two, the values do not differ much.

How to choose the high-impact foods can differ. This thesis makes one suggestion, but other ways of choosing are also available. Instead of basing the included high-impact food categories on the calculated intensities, one could either base the choice on other sources. For example, basing the high-impact food categories on the unit $kg\ CO_2\text{-}eq\ per\ kg\ product$. An alternative would be to base the included high-impact food products on a number of sources, to truly identify the product categories with the highest intensities. Another alternative is to base the included products on the volume of total purchases. For example, one could choose products so that 50 % of the total climate impact of all products was covered.

4.2.2 Red meat and dairy

An alternative is to focus on specific categories of foods. As an example, products procured from ruminants are known to be related to high climate impacts [26]. Focusing on a specific category of high-impact food can therefore also be of interest for retailers, if they want to improve their sustainability performance. In this case, products that was related to ruminants were chosen (i.e. red meat and dairy). The products included in the indicator was beef, butter, hard cheese, cream, crème fraîche, milk, and yoghurt.

Using Equation 3.2, two indicators can be produced in the same way as explained above. Using the intensities in Table 4.1, the final indicator was 0.142 *kg CO_2-eq per SEK*. Comparatively, using intensities based on [27], the indicator value was 0.116 *kg CO_2-eq per SEK*.

Ruminants products can be substituted for other product categories, depending on the intended use of the indicator, but with consequences to other sustainability aspects. The list of included products can also be expanded, provided that the necessary intensities are available.

4.2.3 Animal products

A third option could be to include products deriving from animals in the indicator. Two types of animal products were included in the indicator: proteins and other derivatives (e.g. dairy and eggs). For both of these product categories, a large assortment already exist as substitutes. For example, animal proteins can be substituted by tofu, pea protein, and soy protein. In the same way, milk can be substituted by products based on oat or soy. The animal based products that were included in the indicator was beef, pork, poultry, cod, herring, mackerel, plaice, roe, salmon, shrimp, butter, hard cheese, cream, crème fraîche, egg, milk, and yoghurt.

Using Equation 3.2, two indicators can be produced in the same way as explained above. Using the intensities in Table 4.1, the final indicator was 0.148 *kg CO_2-eq per SEK*. Comparatively, using intensities based on [27], the indicator value was 0.124 *kg CO_2-eq per SEK*.

The choice of what categories of products to include in the indicator can differ. There are many different diets towards which shifts can be seen. The indicator above is based on products that are excluded in a vegan diet. Other diets for which the indicator can be calculated are vegetarianism (for which the indicator does not include fish, poultry, egg, and dairy depending on the type of vegetarianism), ketogenic diets, and pescetarian diets (for which the indicator excludes fish). As stated previously, what to include in a diet based indicator is dependent on what the diet itself excludes. Including only animal based products also have other strengths, not necessarily revolving around dietary shifts towards, for example, veganism. There are many sustainability advantages of eating a more plant based diet [4], aside from the ethical aspect of consuming animal based products.

5
Discussion

This section covers reflections on the general findings of this thesis, issues and possibilities in the data processing, and possibilities of using the indicator as either an internal standard (company-specific or industry agreement), or a regulation.

5.1 General findings

The indicators presented in the previous section are specific for the food retailer ICA, based on their purchase costs and assortment. In essence, this means that the indicators can only be used for ICA. Another area of use is as empirical data for possible future use outside of the company, as an industry-wide tool that can be used for many companies, which will be discussed further on. The methodology explored in the thesis, however, can be used by any retailers meeting the following criteria: access to purchase data for their assortment covering purchase costs and total weights of products, and access to some sort of sustainability data. The sustainability data might differ depending on the intended use of the final indicator, and is not limited to climate change (which is used in this thesis).

As can be seen in the Section 4, the indicator can be useful for a number of reasons. Firstly, the suggested design method is simple and easy to follow. One of the aims of the indicator design is to make it simple and understandable, not involving any unnecessarily complex steps. In this case, the design method is only dependent on two factors: the data availability of the retailer (weight and monetary data), and access to climate data. Secondly, the indicator is versatile in that it can be based on many different sustainability aspects. In this thesis, climate change was chosen as the sustainability aspect, but that does not leave out the possibility of focusing on other aspects. Once again, the chosen sustainability aspect is dependent on what the intended use of the indicator is, and what sustainability data the user has access to. Problems in available data will be discussed in the next section. The versatility of the indicator, combined with the simplicity of the design method, makes the indicator potentially useful for retailers. As a tool for tracking performance, it stands to reason that using a single number is enticing for the retailer. The indicator suggestions produced in this thesis are based on the data of one year (2019). However, the same methodology can be applied to other years as well, giving an overview of the yearly differences of how the retailer is performing. Thirdly, using the indicator to work towards more sustainable performance is a possibility. This ties in with the previous point, of being able to track differences in performance year by year. If the first indicator suggestion is used, i.e. tracking the impact of the most intensive products, retailers can see how the impact of their sales changes year by year. If the retailer uses the indicator to track their progress, they can choose to focus on the high-impact products. Should the indicator be used to track performance year by year, then it is of necessity to use updated climate data for each year. Fourthly, ICA has expressed interest in reducing the climate impact of sold food, as expressed in a recent press release [33]. Using this indicator, while it does not focus on the customers, makes it possible for ICA to gain information on what products to promote.

The indicators that are presented in the thesis uses two different intensities. The reasoning behind this is that information on intensities with an appropriate unit is hard to come by. In the case of climate change, [27] has an extensive list of products, which includes some foodstuffs. Intensities with appropriate units are necessary for the design, meaning that a lack of intensities proves to be problematic. This is the main reason as to why ICA specific intensities have been produced, presented in Table 4.1. It should be stated, however, that using generalized sources, such as Kanyama [27] can be very useful should the indicator(s) be used industry-wide. Unfortunately, data like that in Kanyama [27] might not be broad enough to cover the entirety of the assortment of retailers. Nonetheless, generalized sources are accessible and creates the possibility of easier indicator comparison between retailers.

It is important to point out that the climate data is based on all emissions in the supply chain up to the retail-gate, and thus do not take into account the consumer and end-of-life phases of the supply chain (see Figure 2.1). This choice is twofold: firstly, ICA already guide their customers towards more sustainable practices with *Mitt Klimatmål*, and secondly, the main fraction of emissions in the food supply chain come from the activities preceding distribution. Thus, the retailer exerting pressure on produces and supplies can lead to larger GHG mitigation in the food supply chain, as a retailer using the indicator would try to minimize the emissions from the products in their assortment.

One topic to mention is the limitations of only using climate change as sustainability aspect. While the food supply chain stand for a large amount of GHG emissions, the impact that the supply chain has extends further than that. Only examining GHG emissions hide other unsustainable aspects of the food supply chain. Another issue, almost unique to the food industry is antibiotics use (anti-microbial resistance). The supply chain also uses copious amounts of freshwater and land area [47]. This, in turn, mean that the food supply chain acts a main driver to decrease biodiversity [46]. Most produced food is also never consumed, but how large this loss is still up for discussion. Other aspects of sustainability, relating to the social aspect of the food supply chain would also be interesting to examine. Fair work conditions and production conditions are today partly covered via labelling, but a case could be made that these aspects should be included in indicator design for sustainable food sales. Food security is still an issue in many parts of the world. In other parts of the world, especially the West, nutrition is another social issue that the food industry has to face.

With the suggested unit (*kg CO_2-eq per SEK*), a few notes can be mentioned. Firstly, as mentioned previously, the unit only takes into account climate change. While it covers the most prevalent GHG's, the unit does not take into account other sustainability aspects. Secondly, using *SEK* in the indicator leads to a few pros and cons. The main issue with using an economic factor is that increased margins would leads to an apparent increase in climate performance. This means, in essence, that the improvement in climate performance might not actually be an improvement. The improved performance is hence not an actual improvement at all, but only an increase in margins.

With the aforementioned information, one could see a number of other indicators based on other areas of sustainability. Especially noteworthy is the biodiversity factor, as well as the social aspects. If one want to move towards a more sustainable food system, indicators can be very helpful. One could see different types of indicators, covering different sustainability aspects, which combined can give a more complete picture of the issues that the food industry faces. As reporting is, largely, incomplete and brief, presenting information on these aspects can guide retailers (and other actors in the food system) towards more sustainable operations. While this thesis focus on climate, that does not exclude the need for indicators covering other aspects of sustainability. A couple of examples are measuring land and water use akin to Kanyama [27], or nutritional indicators, e.g. in the form of share of turnover coming from unhealthy foods such as sugary products or a positive version which could be share of consumption of healthy foods (for example, following the criteria of 'nyckelhålsmärkning') [48].

5.2 Data processing

There are four main points that warrant discussion with regard to the data processing: the extensiveness of the economic data, the choice of sustainability aspect, trade-offs, and subsequently the climate data itself, and the application of the method on other retailers.

The economic data suffers a few issues, as well as possibilities, with regard to processing and use. As with most food retailers, the assortment is enormous, with products in many different categories. Retailers generally purchase and distribute both foodstuffs and other, non-foodstuffs products. While a majority of the assortment still consists of foodstuffs, the need of eliminating non-foodstuffs when working with the data in the vein that this thesis does is vital. Still, the data with non-foodstuffs excluded will cover a large amount of products. It stands to reason that the choice of product types to include would be decided upon beforehand, and that the scope should be narrowed further than 'all foodstuffs'. Further, it is not to the thesis detriment that only economic data from one retailer was used. The method is still applicable for other retailers, and the data provided by ICA is rather used as an example of how the final indicators can appear. It is worth mentioning that data from other retailers can be used, as well as other climate data. In the case of the climate data, this will be discussed further on. Since the data is from ICA, the intensities produced in this thesis is only applicable to that specific retailer. Because the assortment, purchase costs, and purchased amounts will differ between retailers, it is of importance that other retailers do not use the intensities in this thesis. Rather, other retailers could take the methodology for calculating the indicators into consideration. Finally, other aspects of the operations of the retailer can also be taken into account. Among these aspects, one that is of specific interest is surveying how the indicator would play out when applied on different stores or store types. As mentioned previously, ICA has different store types that are sorted according to size or location. Organizing the data in a simple way not only gives a good overview of important business factors, but would also be of great help when designing indicators, such as this one, or other tracking tools.

The suggested methodology, as well as the available data, creates trade-offs in the selection of included products that need to be discussed. The largest trade-off is that mixed products (such as ready-meals) could not be taken into account due to lack of data. Most of these mixed products contain ingredients that are presented in Table 4.1, such as different meats, root vegetables, and legumes. When mixed products are not included, the results are skewed. For example, if the meat products in ready-meals are not included in the meat category, not all meat is accounted for. This creates a discrepancy that is important to keep in mind. Preferably, these products should be taken into account, for the sake of a more viable and complete result. The size of this discrepancy is difficult to estimate.

Coming back to the extensiveness of the data, another issue arises in the data processing described in the methodology. Due to the way ICA has formatted their data, it can at times be difficult to navigate the data, especially in the elimination and identification steps. These issues have been mentioned in the methodology, but bares repeating. As a large part of the methodology required working product by product, there is a possibility that products can be missed. Despite creating overarching categories, products need to summarized in those overarching categories. In this step, the risk of not taking into account every product is the largest. How large the discrepancy might be is impossible to say. Avoiding this discrepancy can be achieved in two ways. Firstly, the formatting of the economic data. Once again, it is impossible to say how, and if, other retailers have data like that of ICA. Is the data presented in a simple and easy way to sort it, then one might not run into this issue. Secondly, thorough examination of the data is essential. Unfortunately this level of thoroughness is hard to achieve in this thesis, simply due to lack of time.

5.3 Sustainability aspects

The choice of sustainability aspect to use in the indicator design phase have been mentioned and motivated previously. Nonetheless, due to the range of sustainability aspects that the retailer can choose to use in the indicator, other sustainability aspects need to be mentioned and discussed. In this thesis, climate change (i.e. GHG emissions) was the decided upon sustainability aspect. This choice entails that sustainability factors with regard to economics or social issues are put on the sideline. The main explanation for this is twofold: data availability and ease of quantification. Data availability, as with all research and indicator design, is constantly an issue. The scope of this thesis was not to perform an assessment to produce sustainability data, and thus had to rely on what data was available and easily acquired. Unfortunately, data availability is sparse, or very specific. Because the food system stands as a contributor to a plethora of sustainability issues, covering both ecological, economic, and social sustainability, a plethora of choices are also available. With regard to ecological sustainability, land use, water use, pesticide use, use of antibiotics, and eutrophication can be mentioned as sensible sustainability aspects that could have been used instead of climate change. In the same vein, social sustainability aspects relating to labels (e.g. fair-trade) could also be considered. Unfortunately, this data is not easily acquired if one does not conduct an assessment beforehand.

These aspects also lead into the second issue with the sustainability aspect, namely the ease of quantification. It is generally accepted that climate change is measured using emissions of GHGs. For other sustainability aspects, it is not always a general consensus of how they should be measured. This issue is especially apparent in social sustainability aspects. What to measure, as well as what to include in those measures are not generally agreed upon, and can differ greatly.

A third issue, which is not as general as the previously mentioned issues, is that ICA already uses similar indicators in their tool *Mitt Klimatmål*. If the retailer used in this thesis already uses some tool or indicator for tracking their climate impact, it stands to reason that a similar way of measuring and reporting would be useful and understandable. This last point will be discussed further in Section 5.4.1. Another point worth mentioning is what climate, or sustainability, data to choose. In this thesis, three different data sets are suggested: Moberg [26], Röös [32], and RISE [31]. While the reason for choosing Moberg's [26] data was described in the methodology section, other data could also be applicable. Once again, the importance is what goal the retailer wants to meet, what progress the retailer wants to track, or what data the retailer have access to.

Another issue that has to be taken into account is trade-offs between sustainability aspects. Working towards set goals on climate change might lead to unforeseen consequences with regard to other sustainability aspects. Therefore, it is of interest to broaden what sustainability aspect to use. While including more sustainability aspects would require more time, it would make it possible to avoid sub-optimization in the long run. A pre-existing example of working towards a more broad sustainability is how Swedish retailer COOP uses sustainability declaration (*Hållbarhetsdeklaration*). This is a type of labelling, focusing on showing the sustainability of products in COOP's assortment, based on the Sustainable Development Goals (SDG) [49]. The declaration is set to be enacted in COOP stores by 2021.

5.4 Future use of the indicator(s)

Below follows ideas and suggestions on how the indicator(s) can be used in the future.

5.4.1 Possibilities as an internal standard

As gatekeepers of the food supply chain, retailers have a unique role in moving the food industry towards more sustainable practices. Therefore, internal standards in food retailing can contribute to decreasing the food industry's overall impact, be it climate impact, or other sustainability aspect. The exact way this indicator could achieve such a change is hard to foresee. Initially, this thesis aimed at conducting an internal focus group discussion with ICA, to analyse what the indicator could be used for. Due to time constraints and the COVID-19 situation, this focus group activity could not be performed. Despite the lack of such an activity, some ideas can still be lifted. Using the indicator as a tracking device for the retailer's sustainability performance is the most important factor. While ICA already has knowledge of customer habits and emissions, upstream activities are at large not mapped out. The indicator, then, could be used to give somewhat of a grasp of the retailer's Scope 3 emissions. The climate impact of the food products included in the indicator is allocated to the production and distribution. This, in turn, means that a large fraction of the emissions are tied to activities outside the scope of ICA's own operations. Although the majority of emissions are external to ICA, the retailer is still an influential actor in the production system which give rise to these emissions. Therefore, using the indicators can give a basic grasp of their Scope 3 emissions in the way that they can gain information on problem products. It can also be used to follow trends in consumption, and provide information on what changes in consumption patterns can do to ICA's overall climate performance.

ICA specific possibilities are also of interest. With *Mitt Klimatmål*, ICA can grasp the emissions on the consumption side. Pairing this tool with an indicator for total purchases/sales, ICA achieves an overview of the total impact, both on the production and consumption side. ICA has set the goal of continuing to find ways to quantify and minimize their climate impact. This type of indicator can also be used to work towards the Sustainable Development Goals (SDG). These projects are still in their infancy, and can be combined with the indicator(s) explored in this thesis to chart their total emissions. Standing for the, by far, largest market share in Swedish food retailing, ICA not only becomes a gatekeeper in the traditional sense. If ICA decides to put resources into working towards more sustainable sales, other retailers might follow suit in order to remain competitive. With the power that comes with having the largest market share, ICA could indirectly or directly push for industry agreements towards more climate-friendly food retailing. The indicator(s) could for example be used to set internal climate targets. For example, ICA could set the internal goal of lowering the climate impact of their sales year by year, to push for sustainable retailing. Should ICA push for an industry agreement, other retailers could do the same. The indicator(s) would then be company specific, as they are based on purchasing costs, and each retailer would produce their own indicator(s). Another suggestion is creating an overall indicator for the industry as a whole, as an industry agreement. With the ideas regarding UK food retailing in mind, as mentioned in Section 2.1.2, the indicator(s) could also be used as a tool for tracking year-to-year performance of UK retailers.

As discussed previously, other sustainability aspects could also be of interest with regard to industry and internal performance. Having a way of tracking, for example, unhealthy foods or eco-labelled foods is also something that retailers might find attractive. What unit to use for the indicator in those cases is harder to define, but nonetheless a possibility. Tracking unhealthy food, using an indicator with the same design methodology but another sustainability measure (i.e. not *kg* CO_2*-eq*) is possible, as mentioned previously in Section 5.3. This requires effort on the part of the retailer, however, to produce or find that type of sustainability data. The same is true for, for example, eco-labels. Nevertheless, the retailer can then track year by year improvements in their assortment. The intended use of the indicator and its design methodology is, as stated previously, versatile. The only requirement is that data for the sustainability aspect is available. With the knowledge provided by ICA [50], this is something that ICA has shown interest in. Should the project be launched in the intended way, ICA would become part of creating a library of sustainability data, which would make the design of indicators with other sustainability aspects easier.

Another way for retailers to use the indicators is to use the knowledge and limitations put upon them by the indicator for in-house benefits. If a product would be included in the indicator, a way to improve the performance would be to avoid that product. Instead, less intensive products could be promoted. For example, promoting plant-based protein alternatives, such as soy or pea protein, would be beneficial to the retailer, as promoting red meat would not be beneficial for the retailer with the indicator in mind. However, the risk of sub-optimization is important to keep in mind, as substituting products can lead to unforeseen consequences. Product promotion, store exposure, and campaigns could all be tailored to comply with either targets/demands of increased performance in relation to the indicator. The indicator could be an internal standard, industry agreements, and even possible as part of a government regulation (see Section 5.4.2). The use of the indicator should therefore not be seen as a business restriction, but rather an opportunity to increase environmental performance as well as staying in-line with the current demand of consumers. If, for example, customers are demanding meat alternatives, then an indicator including animal protein could promote more sustainable performance, but also create new business opportunities for the retailer.

5.4.2 Possibilities as regulation

One can see regulation as a potential future step, after the previously discussed internal standard and industry agreement. Indicator(s) in line with the ones explored in this thesis can be used as the foundation for climate regulation in the food industry, whatever form that regulation might take. A number of questions have to be solved, when translating the indicator into empiric information to be used in regulation. However, the possibility of using the indicator(s) explored in this thesis is still in its infancy. To create an industry-wide regulation requires all retailers affected by the regulation the performance for the indicator. Insights from the case of regulating climate performance of sales in the automotive industry could be used [8, 9]. With the apparent success of this kind of standard or regulation, such as the CAFE standard, it could be used in a similar fashion in the food industry, something which is briefly discussed in a recent report [48]. By setting demands for improved climate performance for food sales, the indicator can be used as a guiding value. As such, retailers in Sweden would have to comply to the guiding value, and would not be allowed to surmount that value, otherwise sanctions would be imposed. Once again, seeing the retailer as a gatekeeper in the food supply chain entails that the entirety of the food supply chain can be affected by regulating the retailers. While the retailers direct emissions stand for a rather small fraction of the overall GHG emissions of the food supply chain, bridging the gap between producers and consumers give retailers a powerful role to play. It also makes the retailer a potential actor for applying regulations that regard the sustainability of food production and distribution. Using the example indicators produced in Section 4.2, a few ideas can be lifted.

Focusing on high climate impact foods is one way of approaching the regulation. By mapping what products have the highest climate impact, these products could be included in the indicator. As a way of decreasing the climate impact of these specific products, then, a guiding value would be set with regard to how large GHG emissions a purchased group of products might have. What this would result in in the long run is hard to foresee, but one could imagine that a reduction in high impact food purchases could be a possibility.

Focusing instead on specific product groups that are known to have high climate impacts is another way of approaching such a regulation. One of the indicator suggestions was to focus on products tied to ruminants, such as beef and dairy. It is known that parts of the production of beef is unsustainable, although it still contributes positively to ecosystem services and biodiversity. The idea is the same as previously stated, i.e. trying to minimize the climate impact of a group of high-impacting foods. The overall idea of regulating the mentioned products and product types is to reduce the climate impact of the total food system, by using the retailer as the catalyst to drive such a change. With the goals announced by ICA recently, such a regulation could be a step in the right direction. This would create external pressure on food retailers to improve their sustainability practices, which in turn could help with achieving internally set goals. Other regulation would also be possible using the indicator design method. Focus on nutrition, for example, is a possibility. While the indicator(s) produced in this thesis would not be applicable, the indicator unit could be changed to better fit such a regulation.

Using the fuel economy standard as inspiration can give rise to issues, however, as one cannot simply compare the automotive and food industry on a whim. While the products produced and distributed by the two industries, i.e. vehicles and food, can be deemed as necessities in today's world, they are still different. Sustenance is vital to human life, and something that we cannot simply do without. This, paired with the extreme complexity of the food industry, mean that regulating food is not particularly straightforward. Another factor that plays a part is the possibility of measuring climate impact. The automotive sector have standardized tests that product values of emissions per personal kilometer. Once again, the complexity of the food system plays a part.

The automotive industry can change production and innovation in directions not desirable to reach set targets using, for example, fuel economy standards. Looking at trends in the automotive industry, one issue with fuel economy standards is that the prices of products can be driven up [51]. This is due to new techniques and innovation requiring more complex methods, therefore increasing production costs. While this is an issue, access to public transportation and car pooling can help mitigating the increasing costs. If the same would be a result for the food industry, however, this would pose a problem. Increasing costs of food products due to heavy regulation is undesirable, as food is a necessity. Using an indicator based on purchase costs of retailers can, therefore, in turn result in price increases of certain food items. With ecological sustainability in mind, more pricey high climate impact foods would reasonably result in customer interest, hence decreasing emissions for consumers. On the other hand, with social and economic sustainability in mind, this is most certainly an issue. Food security can increase prices, leading not only to economic issues, but also issue with nutrition. On the other hand, fuel economy standards have pushed innovation. A regulation as such could push for innovation in production methods and products, to meet the changes in purchase methods. Also, other unforeseen issues might arise with new production methods, meaning that the pressure put upon retailers, and thus producers and suppliers, may lead to unexpected problems earlier in the supply chain. What form these issues might take, and if this would be an issues at all, is unfortunately hard to say.

6

Conclusions and further research

The following section will summarize the points discussed in Section 5, as well as giving some further ideas for future research for the use of indicators in food retailing.

Retailers have an important part to play when it comes to combat not only climate change, but a number of problematic sustainability issues in the food supply chain. However, lack of consistency in reporting, and clarity in actual sustainability work leaves much to be desired. Using indicators, such as the ones explored in this thesis, can be of help for retailers to use in goal-setting, in steering which actions to take, and in tracking of progress. Due to the versatility of indicators, retailers can use indicators to track many different unsustainable aspects either in, or tied to, their activities. What is needed is consensus and consistency. A specific future indicator design could build the basis for that consensus and consistency, whether it be via some sort of internal standard, industry agreement, or regulation, at least with regard to climate change. This thesis has explored indicators that only take into account climate change, but this does not mean that the same methodology could not be used for other sustainability aspects. What is needed is relevant and accessible data. Also, deciding on what types of products to include in indicators is something that might be further studied by the retailers themselves, by studying sale trends over the years.

To move the ideas around indicators for sustainable food sales forward, a few things are needed. Firstly, further work on what types of indicators that are preferable and needed for food retailing need to be analysed. These indicators could range from covering climate change to nutritional indicators and indicators on biodiversity. Secondly, retailers need to be more deliberate in the way they handle their data internally. One of the issues with these types of indicators are the inaccessibility and expansiveness of the retailer data. Thirdly, more research on how these indicators could be used in industry-wide agreements or even in regulations is needed.

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A

Appendix 1: The product categories of interest in ICA's assortment

Below follows a list of products that were of interest in ICA's assortment. The list is the result of elimination of non-food products, as well as hard to define products.

Table A.1: Products of interest in ICA's assortment

Category	Root vegetables	Legumes	Mushrooms	Berries	Onions	Fruits	Meats	Fish and shellfish	Processed products	Food grains	Dairy, cheese and egg
Products	Artichoke Beetroot Carrot Celeriac Chioggia beet Daikon Horseradish Kohlrabbi Parsley root Parsnip Potato Rutabaga Sweet potato Turnip Yellow beet	Alfalfa Arugula Asparagus Aubergine Avocado Beans Bell pepper Black kale Brussel sprouts Cabbage Capers Cauliflower Celery Chestnut Chickpea Chili Corn Cress Cucumber Fennel Galangal Ginger Habanero Haricot verts Jalapeño Kale Lemongrass Lettuce Ochre Pak choi Pea Pine nut Pumpkin Radish Red cabbage Rhubarb Salsify Savoy cabbage Spinach Sundried tomato Tomato Turmeric Water chestnut Wax bean Zucchini	Champignon Chanterelle Karl Johan Morel Oyster mushroom Portabello Shiitake Yellowfoot	Acai berry Blueberry Cherry Cloud berry Cranberry Curant Lingon berry Mull berry Raspberry Strawberry	Chives Garlic Leek Pearl onion Ramson Red onion Schallottes White onion Yellow onion	Apple Banana Blood orange Carambola Clementine Date Fig Grapefruit Grapes Grenadilla Kiwi Kumquat Lemon Lime Melon Orange Papaya Passion fruit Peach Pear Persimmon Physalis Pineapple Pitaya Plum Pomegranate Satsumas	Beef Boar Deer Duck Goose Hen Lamb Minced meat Moose Pork Poultry Reindeer Turkey	Anchovy Baltic herring Cod Crab Crayfish Eel Escargots Haddock Herring Lobster Lutefisk Mackerel Mussels Plaice Roe Salmon Sardine Shrimp Squid Tuna White fish*	Bread Margarine Pasta	Bulgur Couscous Quinoa Rice Whole wheat	Butter Cream Cream cheese Crème fraîche Cheese Cottage cheese Egg Food yoghurt Greek yoghurt Milk Quark Russian yoghurt Smetana Soft cheese Sour cream Sour milk Turkish yoghurt Yoghurt