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by

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Reducing Greenhouse Gas Emissions in the Food Sector: Effects of Corporate Responsibility*

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Abstract

The number of firms in the food and agriculture sector that have corporate responsibility (CR) strategies and corresponding reporting is growing rapidly. Many aim, amongst other objectives, to reduce greenhouse gas (GHG) emissions. The question we address here is to what extent such CR measures actually have the potential to significantly affect overall GHG emissions from the agriculture and food sector. We analyse the CR strategies of a sample of 40 firms and from this we provide an assessment of how corporate responsibility addresses GHG emissions. This is achieved in three steps. First, we assess to what extent CR activities are impacting on relevant emission sources. Second, we analyse their current reach and ambition in terms of change envisaged and their contribution to climate protection as a global public good. Third, we consider the drivers behind the development of corporate responsibility to mitigate greenhouse gas emissions in order to estimate the longevity and likely future ambition of these programmes. In addition, we identify firm characteristics that are correlated with strong corporate climate responsibility.

Keywords: greenhouse gas emissions, corporate responsibility, corporate climate responsibility, food value chains

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1. Introduction

There has been a great increase in the number and scope of corporate responsibility (CR) strategies and activities over the last 15 years. KPMG (2013) estimates that in 2005, 90 % of Japanese companies, 71 % of UK companies and 32 % of US companies participated in CSR reporting. By 2013, almost all of the 250 largest companies in the world were reporting on CR (KPMG, 2013). Global food and drinks businesses such as Coca-Cola, McDonald's and Nestle have CR strategies that, amongst other objectives, aim to reduce greenhouse gas (GHG) emissions. We refer to this aspect of CR as 'corporate climate responsibility'. The question addressed here is to what extent such CR measures have the potential to significantly affect GHG emissions from the agriculture and food sector?

We are the first to provide systematic evidence on the scope and potential contribution of the growing CR phenomenon with respect to its actual reducing GHG emissions from agriculture and food. With our analysis of CR strategies from a sample of 40 firms, we show the ambition and reach of these strategies and identify patterns based on firm characteristics. Building on an assessment of the drivers behind corporate climate responsibility, some ideas on how strategies and activities can be better used to effectively contribute to climate change mitigation are provided.

The agri-food sector is certainly an important target for corporate climate responsibility. Food is estimated to be directly and indirectly responsible for 20-30% of global GHG emissions (IPCC 2007). Hertwich and Peters (2009) estimate that food (excluding land-use change) is responsible for 27% of global GHG emissions compared with 26% for heating, cooling and lighting, and 20% for transport. National and regional studies support these global assessments (Garnett 2008 and Audsley et

al. 2009; Tukker et al. 2008). The animal-based component of the food system is a major source of these emissions. Emissions from livestock account for 12% (Westhoek et al. 2014 and 2011) to 18% (Steinfeld et al. 2006) of global emissions.

2. Approach and methods

This research is based on quantitative and qualitative analysis of data and CR material published by 40 agri-food firms (Table 1) that engage in CR activities. The quantitative analysis concentrated on identifying patterns in the data gathered for the 40 firms. Only tangible measures and aims were examined, i.e. measures which are clearly translated into activities which can be monitored. These data relate to the number of activities firms supported that are relevant to reducing GHG emissions, firm size, sector, capital intensity, country of origin and their role in supply chains. We complemented this with a qualitative analysis of the CR documents published by the 40 firms. Based on these analyses, we classified CR strategies and activities in relation to their potential impact on GHG emissions and their potential for inducing larger change processes in the food sector. In addition we looked for drivers and patterns across firms that may provide entry points for policy makers or sector-wide initiatives. The quantitative and qualitative analyses were conducted independent of each other and the results of these were brought together to form our conclusions.

2.1. Sample selection

This study uses a sample of firms that have CR strategies that potentially affect GHG emissions. Firms in the agricultural and food sector in a wider sense, including processing (e.g. Arla) and catering (e.g. McDonald's) were sampled. The sampling strategy was based on a structured search process. In the first step, short interviews

with industry experts were conducted to help identify firms that are involved in CR activities relevant to reducing GHG emissions. Reports by international governmental and nongovernmental agencies were also examined with the same aim. We then drew up a list of candidate firms and used size, type of firm and country of origin as strata for inclusion in the sample, aiming at maximizing diversity in these factors, including smaller firms as well as the very large players. Language was a constraining factor and as a result our sample comprises firms mostly based in North America and Europe. These large players have significant impact on global markets (Kahn and Kok 2014). At the end of this process, 40 firms were identified and included in the study. From this we identified three categories of firm according to their market position in supply chains (Table 1).

Table 1: The sample of firms categorised according their role in supply chains

Firm	Category	Firm	Category
Associated British Foods	1	Klasmann Deilmann	3
Archer Daniels Midland	3	Kraft Foods	1
Alfred Ritter GmbH & Co. KG	1	Marks and Spencer	2
Arla Foods	1	Mars	1
Barilla	1	McCain Food	1
Barry Callebaut	3	McDonald's	2
Cargill	3	Morrisons	2
CocaCola	1	Nestlé	1
COOP	2	Peeze Coffee	1
Del Monte	1	PepsiCo	1
Danone	1	PHW Group	1
Ferrero	1	Provamel	1
General Mills	3	Sainsbury's	1
Glanbia	3	Starbucks	2
Gulpener Bier	1	Stora Enso	3
H.J. Heinz Company	1	Sustainable Restaurants Association[a]	a
Hershey	1	Tesco	2
Hipp	1	Tchibo	2
John Lewis Partnership	2	Unilever	2
Kelloggs	1	Walmart	1

1. Firms with specific consumer products, typically food product manufacturers that are often known to consumers through their brands such as Heinz.
2. Firms interacting with consumers over a wide range of products and supply chains, such as retailers and caterers.
3. Firms not interacting directly with consumers, typically commodity traders and commodity processors.

[a]The Sustainable Restaurant Association represents a group of restaurants and does not easily fit into the categorisation.

The categorisation above helps frame an assessment made in relation to the potential market drivers behind CR. Firms in the first category generally have a relatively high degree of control of their supply chains. Brands are central to their business models. These brands are valuable. This means additional costs arising from investment in CR measures can potentially be offset by an economic returns from the strengthening of the brand. In some food sectors, ownership or control of the supply chain may extend down to primary production and even pre-farm activities, for example in the poultry sector where manufactures of food products own feed manufacture and even the breeding of advanced strains of livestock.

From a CR perspective, the second category is similar to the first, but ownership of CR activities lies with the retailer/caterer and extends across a wide range of food products. Therefore the scope for supporting change at the food system level is greater. In the United Kingdom, four multiple retailers control 75% of the grocery market (Kantar Worldpanel 2013) and 'own-brand' accounts for nearly half of their food sales (Gibbons 2012). In Germany, five leading retailers account for 73% of the market in Germany (Statista 2014).

Firms in the third category are typically active in commodity processing and trading and some control key parts of supply chains, but are largely invisible to consumers. They interact intensively with farmers or local commodity traders, process and store commodities, and then transport them over long distances. These firms operate in a particularly competitive commodity trading environment, where the scope for branding and product differentiation is limited.

Because the information base comprises CR information provided by firms, the activities of large firms may be under-represented because minor or local activities

operated by branches of the company may be overlooked in corporate reporting. However, countering this, large firms may have more sophisticated CR support systems and report more than smaller firms. To help reduce uncertainty arising from this, we gave each firm the opportunity to comment on a draft version of this paper and complete the information. Several firms responded with additional information or clarification.

3. Approach to corporate responsibility in agriculture and food sector

The European Commission (European Commission 2011) defines corporate social responsibility as "the responsibility of enterprises for their impacts on society". To fully meet their social responsibility, enterprises "*should have in place a process to integrate social, environmental, ethical human rights and consumer concerns into their business operations and core strategy in close collaboration with their stakeholders*". The German Federal Ministry of Labour and Social Affairs (Bundesministerium für Arbeit und Soziales 2012) emphasises that CR means voluntary commitments that go beyond what is required by law.

For the purpose of this paper, we define CR broadly, taking into account all CR measures and instruments reported by companies as CR with relevant to food-related GHG emissions including in particular semi-private and private certification schemes. In the case of agriculture and food, the primary resources are land and water, and the suppliers are almost always millions of farmers competing in open commodity markets. Because of this, CR in farming and food extends well beyond the activities of the operating firms to include their suppliers.

The impact of CR on GHG emissions is determined by the effects of the measures used on the supply-chain activities and processes that cause GHG emissions. An

overview of the measures that we found in the sample firms CR strategies is provided as follows.

3.1. Agri-food certification

Production certification verifies compliance with defined criteria. A set of these criteria forms a standard. Certified adherence to a standard allows the use a label that indicates that the producer has adhered to the standard. Some of these standards are owned by farmers. Others are owned by NGOs, private organisations, and state or semi-state bodies. Some labels function similar to consumer brands (e.g. Fairtrade and organic); others are relevant to trade between businesses only (e.g. GlobalGAP). The use of voluntary certification for food and agricultural products have increased in number and importance in recent years. In 2010, the EU identified more than 400 different certification systems (European Commission 2010). Certification of agricultural production may focus on the whole farm business (e.g. LEAF, UTZ, Rainforest Alliance), supply-chains (Red Tractor, organic), or apply to commodities such as palm oil or soy. There are combinations of these approaches and some certification schemes incorporate several of these.

3.2. Carbon certification, offset and trade

As with other certifications, carbon certification is usually a third party process which enables the use of a carbon label. These labels can apply to products, production processes or firms. They include certification for carbon rating, carbon intensity, carbon reduction and carbon neutrality. Their use is increasing with the development of more sophisticated carbon measurement systems (see Table A.1). Carbon certification is based on an estimate of emissions. Carbon certification can apply to products, processes or firms. Some certification schemes are focused on estimates of emissions. This is the case for carbon intensity and rating labels. Others require

firms to take action to reduce emissions by reducing emissions or by buying carbon credits (carbon offsetting). This is the case for low carbon and carbon reduction labels. Carbon offsetting is used as part of a carbon certification or separate from it. Offsetting can be done through voluntary or compulsory schemes. Compulsory schemes are the clean development mechanism (CDM), or the EU emission trade and joint implementation scheme (UNFCCC). Voluntary schemes include amongst others the Gold, CarbonFix and VER plus Standards.

3.3. Cooperation and partnerships

A cooperation or partnership is defined here as an explicit arrangement with another firm or NGO (or several) for a specific purpose. They are often 'roundtables' and constitute trust-based voluntary peer groups. This makes them a low-cost option for participants compared with other activities. NGOs such as the WWF and a number of leading food brand owners (e.g. Unilever, Nestle, Danone and Mars) have played a leading role in these. Activities range from contributing to exchange platforms and lobbying partnerships to establishing commitments among their members. These roundtables are also used for pre-competitive collaboration to address strategic or far-reaching goals. Membership has awareness-raising effects and there are benefits from shared insights and information. Roundtables also operate certification programmes. It is possible to purchase or otherwise support certified produce without being a member of the relevant round table, and vice versa.

3.4. Protection of landscapes

In the context of climate change mitigation, restoring ecosystems or landscapes is largely about restoring soil carbon stocks through, for example, re-wilding of farmed land, restoring forests or grassland, or rewetting drained peatland.

3.5. Influencing farm practices

Efforts to Influence farm practice (in addition to changes required by certification schemes) support technical change on farms through training, technical support or the setting of practice guidelines that supplier farms have to follow. These typically seek to increase yield or quality for a given level of inputs such as fertiliser. These include measures such as supporting conservation tillage, the adoption of new varieties, integrated pest management, precision irrigation, and innovations in feeding practice. Firms may require that their suppliers change specific practices or they may create awards and financial incentives for meeting certain environmental criteria. They may promote the sharing of best practices among suppliers, support suppliers in implementing their own carbon assessment schemes and in general raise awareness among suppliers of environmental issues.

3.6. Investing in research

This is largely about investing in research to improve efficiency in agricultural production, including research in pre-farm activities such as plant breeding, and research in energy and other resource use. There is also a wide range of research activities around carbon footprinting and assessment at various levels. Some research activities go beyond the direct interests of firms and extend to wider public interest topics such as climate change in general, diet and health, and general agricultural improvement.

3.7. Technical supply chain measures

Technical supply chain efficiency measures are focused on raising internal resource (in particular energy) use efficiency in processing, manufacturing, transport and retailing and optimising transport, reducing packaging, reducing and reusing waste.

3.8. Consumption change

Influencing consumer choice and demand raises awareness among consumers or actively supports consumers to reduce the intake of carbon-intensive foods and low-impact local or seasonal food. Firms may also engage in consumer education about waste reduction and prevention.

4. Descriptive statistics of mitigation-relevant activities

We identified a total of 166 individual measures implemented by the 40 firms in our sample. The number of measures undertaken per firm is presented in Table 2, counted but not weighted for relevance to GHG mitigation or the extent of application.

Table 2. Number of climate-relevant CR activities identified for each organisation in the sample.

Firm or organisation	Activities	Firm or organisation	Activities
Associated British Foods	28	Klasmann Deilmann	2
Archer Daniels Midland	25	Kraft Foods	20
Alfred Ritter GmbH & Co. KG	5	Marks and Spencer	33
Arla Foods	22	Mars	14
Barilla	17	McCain Food	26
Barry Callebaut	15	McDonald's	25
Cargill	74	Morrisons	25
CocaCola	22	Nestlé	35
COOP	22	Peeze Coffee	5
Del Monte	8	PepsiCo	48
Danone	12	PHW Group	7
Ferrero	18	Provamel	11
General Mills	18	Sainsbury's	26
Glanbia	13	Starbucks	20
Gulpener Bier	3	Stora Enso	6
H.J. Heinz Company	16	Sustainable Restaurants Association	6
Hershey	47	Tesco	12
Hipp	13	Tchibo	25
John Lewis Partnership	34	Unilever	32
Kelloggs	19	Walmart	22

Fourteen groups of activities were identified. The number of cases these activities were implemented by the 40 sample firms is shown in Figure 1.

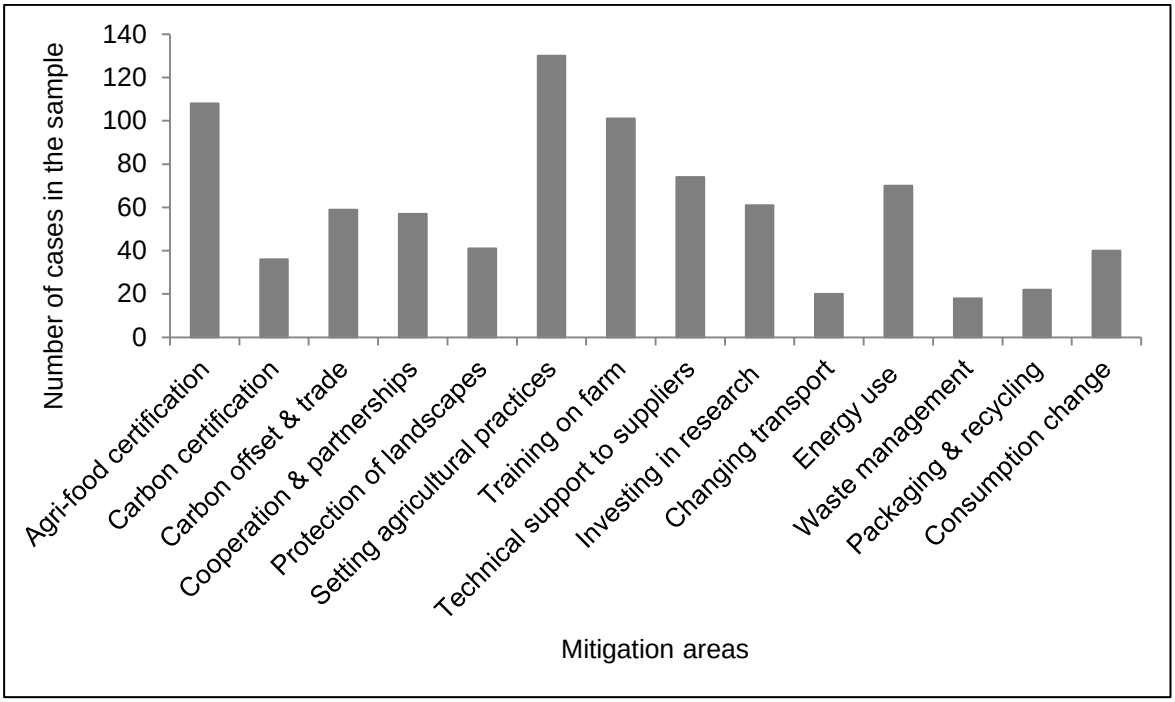

Figure 1: Number of cases of the implementation of GHG mitigation activities by the 40 firms. Each of the 166 activities identified are categorised into one of 14 groups.

Most of the firms in the sample produce or use certified produce or commodities, with firms involved in three certification-type activities on average. These include purchasing produce directly from certified farms; using organic or Fairtrade ingredients; purchasing certified commodities; and purchasing credits for certified production. The most widely used commodity certification is palm oil certification from the Roundtable on Sustainable Palm Oil with 23 of the 40 firms using it. Fairtrade is used by 19 of the 40 firms and is the most widely used supply chain certification used. Certification by Rainforest Alliance is also widely used, as are a range of other certification schemes such as UTZ.

A wide variety of carbon certifications are used by 22 firms. Many of these certify according to more than one, typically two or three. The Carbon Trust standard is the most popular with 5 firms reporting using it. Measuring the firm's own carbon footprint is very common with 32 of the 40 firms in the sample engaging in it, either

for single products or for the business as a whole. All of these firms also have a carbon reduction aim (see Table A.2). 20 firms purchase carbon offsets or invest in carbon offsetting projects.

We identified 57 examples of the use of cooperation, partnership and networking across the sample of 40 firms. The strong participation in partnerships and roundtables reflects a trend towards collectivisation of CR activities. Nevertheless, currently this group of measures includes mainly 'soft' and non-committal approaches. For example, John Lewis is a corporate member of Linking Environment and Farming (LEAF) but does not require compliance with LEAF criteria from its suppliers.

Regeneration of landscapes refers almost mostly to restoration of forest, peat soils or wetlands. It is highly concentrated, with a few firms being involved in several activities in this area and the majority involved in none at all. Those involved include the food giants such as Nestlé and those directly linked to forest ecosystems such as Del Monte and Stora Enso.

Technical requirements imposed on suppliers are often integrated with efforts to influence agricultural practices and include training activities, direct technical support and sometimes even direct implementation of technical improvements at supplier farms. Such measures taken by firms are particularly interesting because they are an indication of firms' influence on primary production. There is a wide array of actions taken from the support for sustainable farming systems to the introduction of new varieties, tillage or irrigation systems. Irrigation water management and organic production techniques are commonly mentioned as targets for training. Even more common are the setting or implementation of standards or definition of key

environmental performance indicators for suppliers; issuing supplier guides or best practice charta, toolboxes and carbon assessment of suppliers/farmers. Supporting the gathering of environmental data and promoting the sharing of best practices between suppliers are also mentioned frequently, whereas financial incentives and awards for desired activities are not common. Such outreach activities are highly correlated with all types of certification. This indicates that certification acts as a catalyst for increased involvement with suppliers. Within our sample, there is a high correlation of (0.75) between the use of different measures to influence agricultural practice and the use of training. These are also jointly positively correlated with certification, signifying that part of these activities may be necessary in order to achieve compliance with a certification scheme.

In total we recorded 61 cases of firms investing in research. Most are research activities supporting carbon assessment and footprinting methodologies and agricultural practices. Generally research activities are directly related to or support other measures. The research supported is often pre-competitive. One such example is the Cool Farm Tool, which is used widely by firms in the sample. It was initiated by Unilever in cooperation with the University of Aberdeen. Through simulation, it estimates emission changes resulting from changes in agricultural practices on farm-level. Several firms have plant breeding programmes (e.g. Heinz and Del Monte). This is a research-based activity which, depending largely on how the plants in question breed (in-bred, hybrid etc.), may also be pre-competitive.

We recorded only 20 instances of measures focused on transport, implemented mainly by the large processors and retailers. This may be partly due to companies not reporting transport changes as part of CR. Of the measures reported, reducing transport distance and moving from road to rail or ship were the dominant ones.

All firms in the sample reported efforts to reduce energy use but a significant number did not specify in detail how they achieve this. Own energy generation, mostly from waste is mentioned by 21 firms. Other examples include installing solar panels (4 cases), improving cooling, heating or processing systems (5 cases).

Measures specifically designed to reduce waste or recycle packaging were not frequently mentioned. On average about half of the firms (22) are involved in some activity. 15% of firms mention the use of recycled or environmental friendly materials and 20 % mention converting by-products or waste into feed. Activities in packaging and recycling are not very frequent and concentrate around a few measures: using certified packaging material, using recycled packaging material and in general environmental friendly material. The use of FSC certified packaging material is by far the most common activity accounting for 59% of all cases. The infrequent mentioning of waste management, packaging and recycling may be to some extent due to the role of regulations in determining practices.

19 firms are involved in some kind of consumer related activity including promoting seasonal, organic**,** vegetarian food and educational activities around climate change, waste and food storage and environment in general. These activities are mainly done by retailers, caterers and firms with strong brands.

The data set enabled us to examine stated targets and progress against them, where existing. The results of this are shown in Table A.2. It is impossible to compare firms, because the basis for the measurement of emissions, as well as their scope varies widely. Some firms account only for emissions from a certain product or production stage or only from energy use, others account for emissions from specific plants or

factories. Some firms go as far as taking their complete emissions including indirect emissions, e.g. from land use change, into account for their emission reduction aims.

In order to identify patterns in the sample, we examined correlations between the firms' characteristics and their use of GHG mitigation measures. Relevant characteristics include where firms are registered, firm age, sector, ownership, turnover, number of employees, or capital-labour ratio approximated by the ratio of turnover to employees. The clearest observation is that companies with many employees tend to engage in many activities (Figure 2), while firms with high turnover per employee tend to have less (Figure 3). This means that relatively more labour intensive firms tend to engage in more activities.

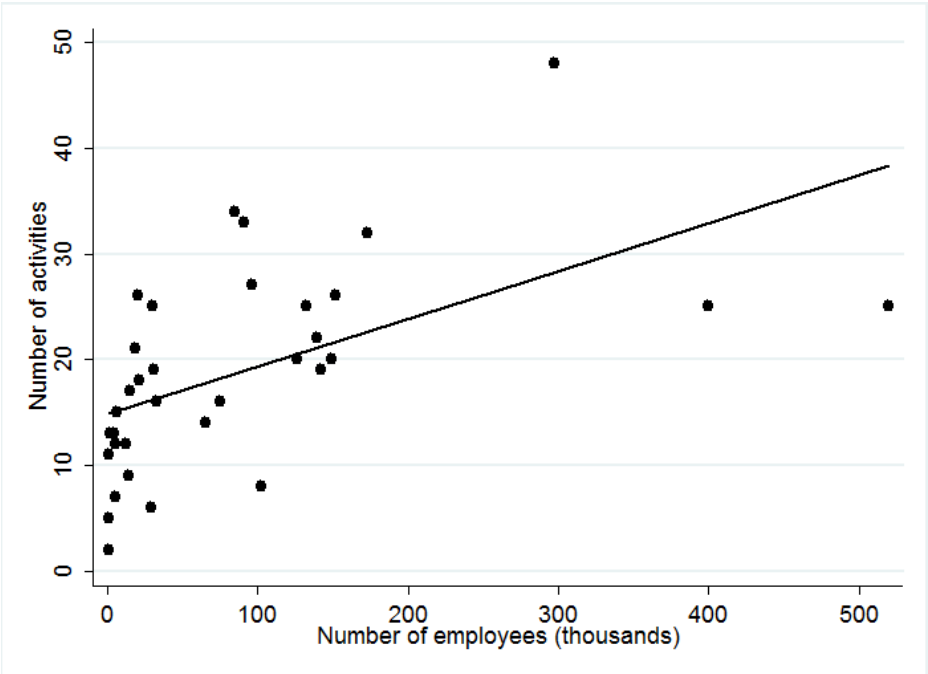

Figure 2: Number of activities of firms and the number of employees they have, with linear fitted line. (Figure excludes two outliers further to the right. The slope of linear fitted values is not affected by this).

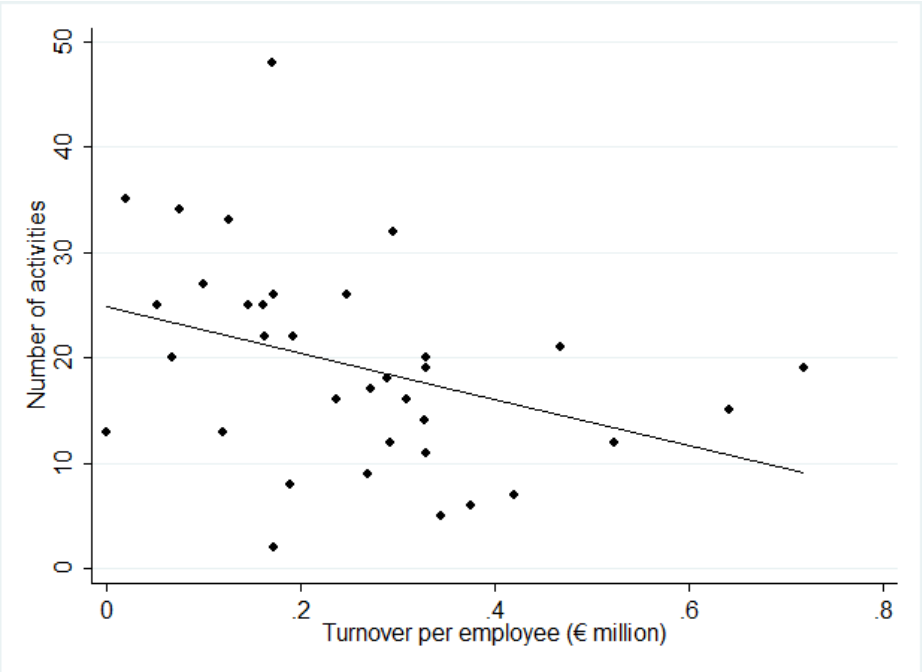

Figure 3: Turnover per employee (million Euros) and firms' activities at all stages, with linear fitted line.

The negative correlation between turnover per employee and the number of CR activities also holds for subcategories of activities such as the number of carbon accounting and certification measures, number of agri-food certification activities, number of activities at supplier stage, etc. Labour intensity is typically high in retail and catering. These firms such as such as Walmart and McDonald's also tend to be businesses that address a wide range of supply chains, interact intensively with consumers, and have valuable brands and may hence engage strongly in CR.

Differences in commitment to activities cannot be attributed to ownership models or to the differences in the political consensus in the countries where firms are head-quartered. There is no significant difference between different firm ownership types and number of activities (Figure 4). It might be expected that mutually-owned firms or publicly listed companies would be more active because they are under stronger public scrutiny, but our data do not support this supposition.

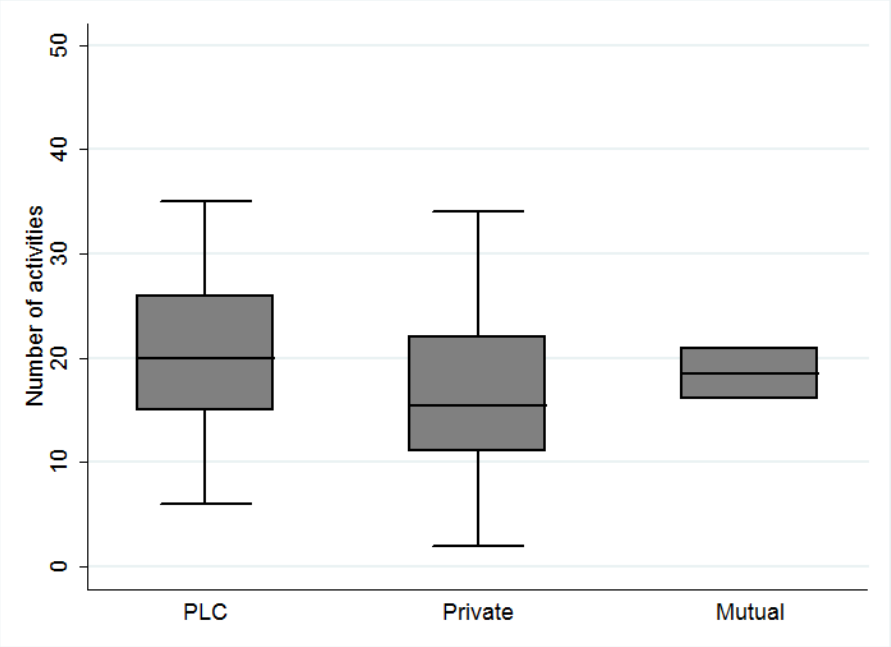

Figure 4: Number of activities for the firms categorised according to company type: publicly listed company (PLC), privately owned, and mutually owned.

Firms' country of origin or base appears to play a slightly stronger role. Within our sample, UK-based companies engaged in a particularly high number of activities. In contrast, firms based in France and Germany are characterised by engagement in relatively few activities and this means that the average number of activities of companies registered in continental Europe is lower than those registered in the UK and Ireland (Figure 5). British-based companies such as Unilever and Marks & Spencer have very strong CR strategies. US-based companies with a strong presence in the UK such as Mars are also characterised by engagement in a wide range of activities. The commitment of UK firms may be related to some quasi-regulatory measures that have emerged in the UK such as the Assured Farm Produce certification scheme that accounts for 70% of British farm produce consumed in Britain. It is also associated with the sector-wide efforts in sustainable development that emerged after the BSE crisis of the 1990s (Cabinet Office 2002;

Defra 2002). CR relevant to GHG emissions is also strongly rooted in Anglo-American business culture according to Becchetti et al. (2013).

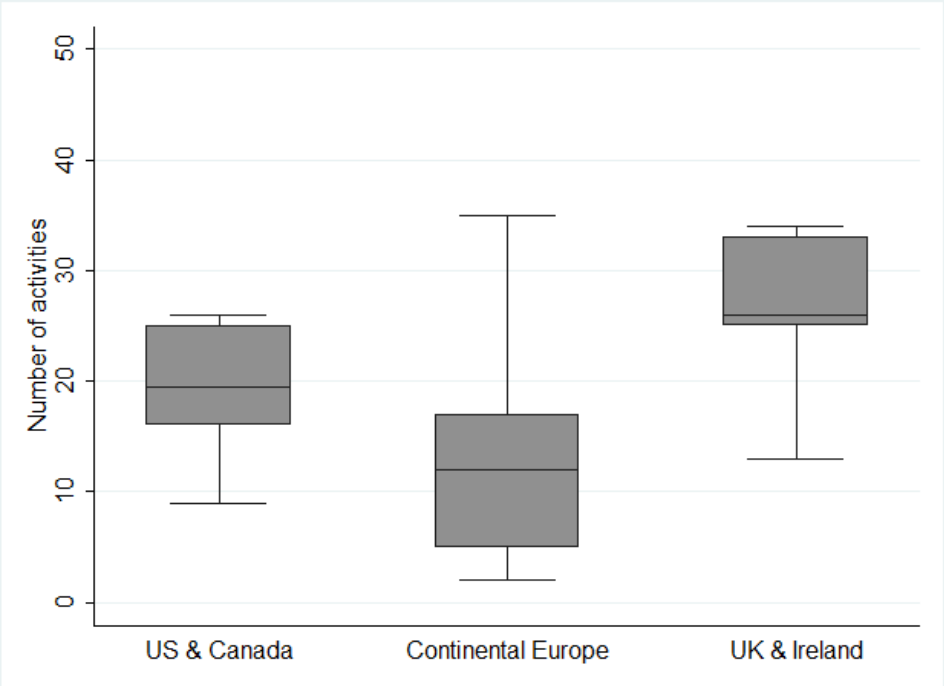

Figure 5: Box and whisker plot of the number of activities for the firms categorised by where they are registered: US and Canada, Continental Europe and UK and Ireland.

Finally, we looked at the number of activities as affected by the relationship companies have with final consumers (Figure 6). This showed that the companies with direct contact over a wide range of products (in particular retailers and caterers) on average engage in the largest number of activities. However, the difference between the categories of firms is not significant, and it is notable that companies such as Cargill that are not present in consumer markets also carry out many CR activities.

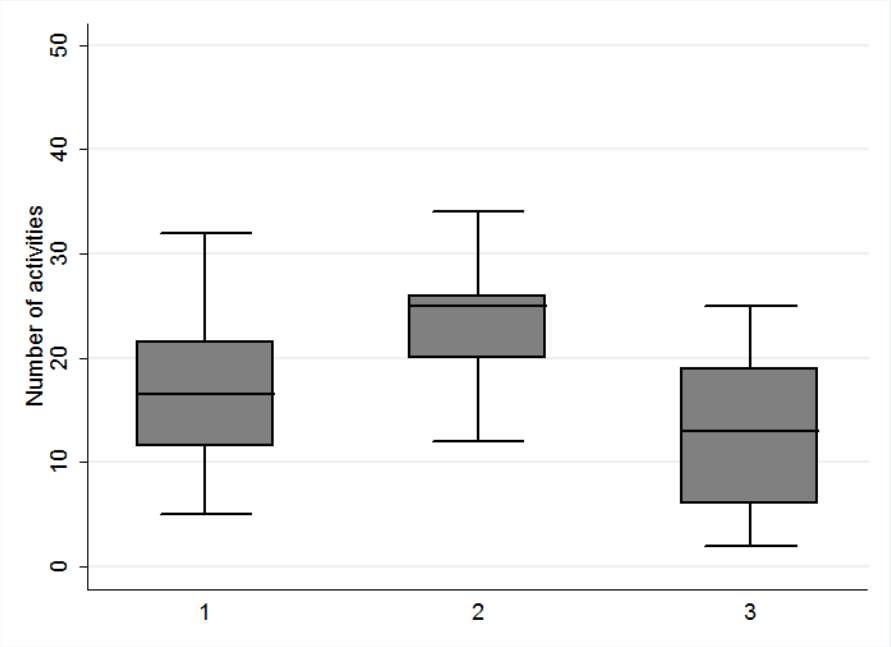

Figure 6: Box and whisker plot of the number of activities for the firms categorised by their connection to consumers as set out above. Key: 1: Firms with branded consumer products – typically food product manufacturers. 2: Firms such as retailers with a wide range of products and supply chains. 3: Firms not interacting directly with consumers (e.g. commodity traders and processors).

5. Analysis of reach and potential impact for CR in reducing emissions

Here we provide an integrated qualitative assessment of how CR in the agri-food sector addresses and potentially mitigates GHG emissions. We do so in three steps. First we assess whether CR activities are covering relevant emission sources. Second, we analyse their current reach and ambition in terms of change envisaged and contribution to the global public good of a stable climate. Third, we identify the drivers behind corporate climate responsibility in order to estimate the longevity and likely future ambition of these programmes.

We first turn to the question of the alignment of the CR activities identified in these 40 firms with the sources of emissions in the food system. By assessing activities in relation to their relevance to the various stages in the supply chain, we can consider how well CR activities focus on the most important sources of emissions. As a basis,

we take the results of the study of sizes and sources of emissions from the UK food system (Garnett 2008 and 2011). These do not include an estimate for land use change emissions. We allocated each use of a measure for each firm to one of the nine supply chain areas identified by Garnett (2008 and 2011) and summed these for the whole sample. The allocation of these to each supply chain stage as a percentage of the total is shown in Figure 7 in relation to the percentage of supply-chain emissions from each stage according to Garnett (2008 and 2011). This shows that generally CR efforts match emission sources in terms of their contribution to emissions from the food chain. This however is a rough estimate since the allocation of activities to sources of emissions is not straightforward. For some firms in our sample, is difficult to separate activities related to retail from those related to catering and we found no examples of firms addressing food-related emissions from activities in the home, for example refrigeration and cooking. In addition some activities such as supporting certification may address several sources.

Fertiliser manufacture, which is the largest source of pre-farm supply chain emissions, is not addressed directly by the any firm in our sample.

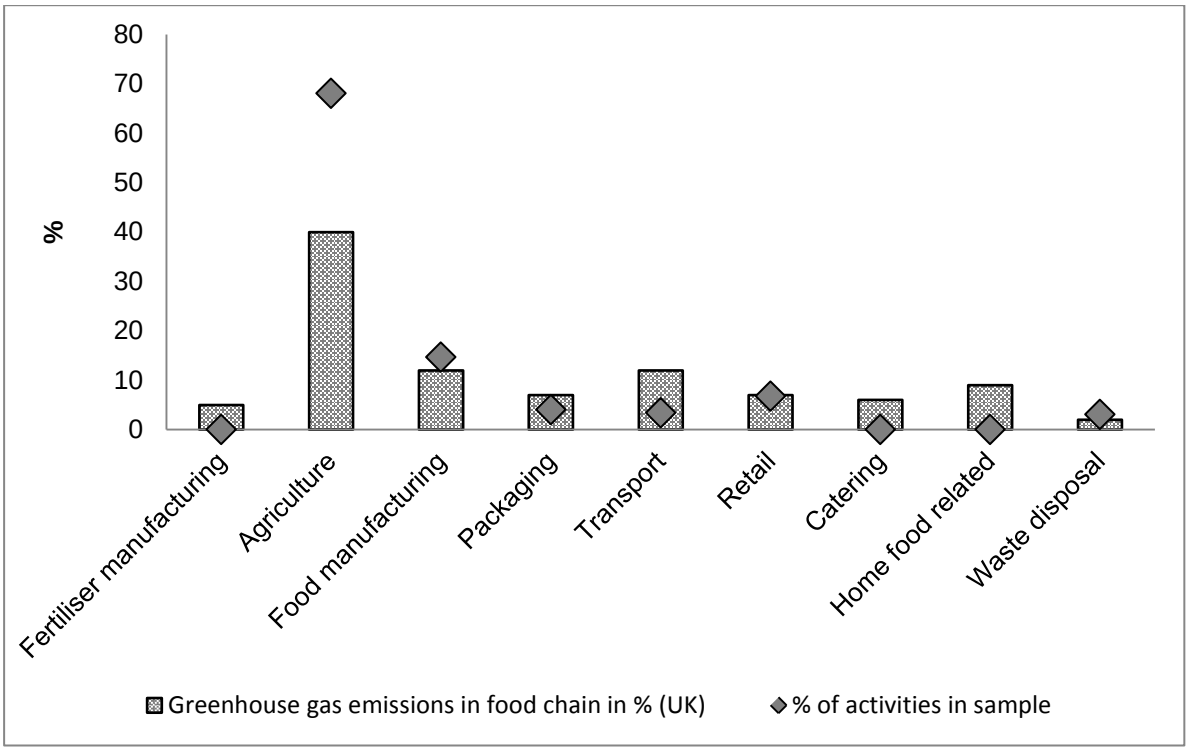

Figure7: Proportion (%) of food-related greenhouse gas emissions from successive stages of the food chain (excluding land-use change – from Garnett 2008 and 2011) and the corresponding proportion (%) of the total number of uses of measures in the firm sample.

We then examined the ambition and reach of the CR strategies in the food sector. We classified the CR strategies according to two dimensions to assess their ambition to reduce emissions. The first is the potential of the activities to drive fundamental change: how far do schemes aim at redesigning production processes, for example by developing new products or business models or encouraging consumption change compared with incremental improvement of existing processes or products. The second dimension is the scope of activities: to what extent are sample firms' CR strategies focused on single products or processes or do they address whole firm activities or whole value chains, including their suppliers and customers. We call the first approach incremental and the second radical or systemic. We placed each firm in relation to the two scales described above to identify the location of each firm in relation to four spaces (Figure 8). We can use an example from outside the food sector to describe cases of companies moving to the right. This is the clothing

company Patagonia which has a “natural growth” programme that amongst other measures advocates buying less. The necessity to eat precludes some radical approaches in agri-food. But there are examples of radical approaches. For instance box schemes in which suppliers deliver fresh produce directly to consumers are radical in that they re-orientate consumers onto what is available with the producer leading on choice. Parts of the organic sector represent a radical re-shaping of the food system through the exclusion of most external inputs and the reorientation of resource flows. This assessment in relation to these two scales enabled the identification of four types of CR strategies relevant to climate protection illustrated in Figure 8.

It must be emphasised here that Figure 8 should not be regarded in any competitive sense. Comparisons between firms on the basis of position in this matrix should be avoided. Rather, the message that can be drawn from Figure 8 is that overall; the great majority of firms are focused on incremental product or process improvement. A quarter of the firms focus on incremental improvements but do so across the entire firm and some beyond into their supply chains. CR strategies that support radical change are confined largely to companies in niche areas, particularly those associated with the organic sector. These niche firms may be driven by other aspirations (e.g. expansion of organic food), which are not necessarily well aligned to reducing GHG emissions. Hence, tipping point change with large-scale emission reduction cannot be expected from firms’ existing CR strategies.

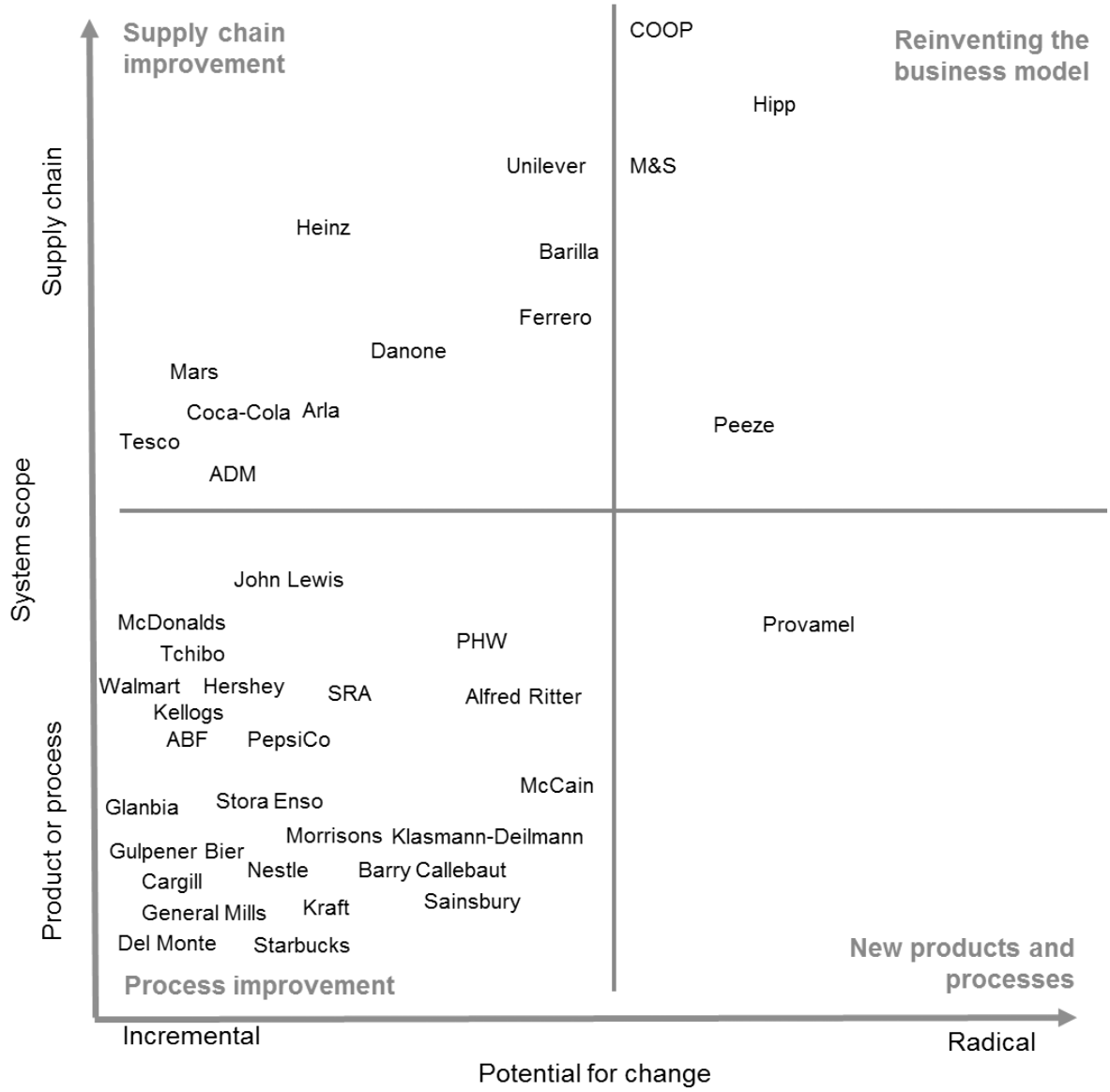

Figure 8: Classification of firms' corporate climate responsibility programmes in relation to the potential for change and their scope over the firms and their supply chains.

The development of CR strategies and activities continued during the global financial crisis of 2007 to 2010 when profits and share values of most publicly listed companies in the food sector dropped. Most firms have developed medium to long-run targets and corresponding investment activities. This growth is particularly clear in terms of the use of certified produce with targets to reach 100% by 2020 common. Similarly, reductions in energy use in operations of up to 20% by 2020 are also

common. In addition, many current strategies set out plans to extend current activities.

We conducted a literature review on drivers of CR and applied the results to our sample of firms. We searched through each firms' CR reports to find and record signs of the different drivers identified from the literature review. This analysis reveals a complex of external and internal drivers operating across the sector with some clear patterns across our sample. Becchetti et al. (2013) identify globalisation as an underlying driving force of modern CR arguing that as consumption becomes more distanced from production, the quest for assurance that production in distant countries complies with consumers' values increases. Several tangible drivers of CR have been identified in the literature including: company values and personal values of the owners and management; strategy and competitiveness; brand and reputation; and avoiding or shaping regulation (Kitzmueller and Shimshack 2012). With respect to climate change, the second driver in the form of cost savings, new business opportunities and consumer preferences was found to be by far the most important (Varnäs et al. 2013) and (financial) risk has also been widely discussed as a reason for CR in climate change (Busch et al. 2012).

The main drivers that we found influencing the firms in our sample are: internal cost reduction, profit generation, and risk reduction. External or internal moral codes which seek peace of mind are less important. By 'peace of mind' we mean efforts which explicitly go beyond management of specific risks to include a more general engagement. The final driver is public policy. The relations between these are set out schematically in Figure 9. We have identified four types of responses to these drivers on the part of firms: pursuit of informed self-interest; brand enhancement; support of mutuality and partnerships; and pioneering investment.

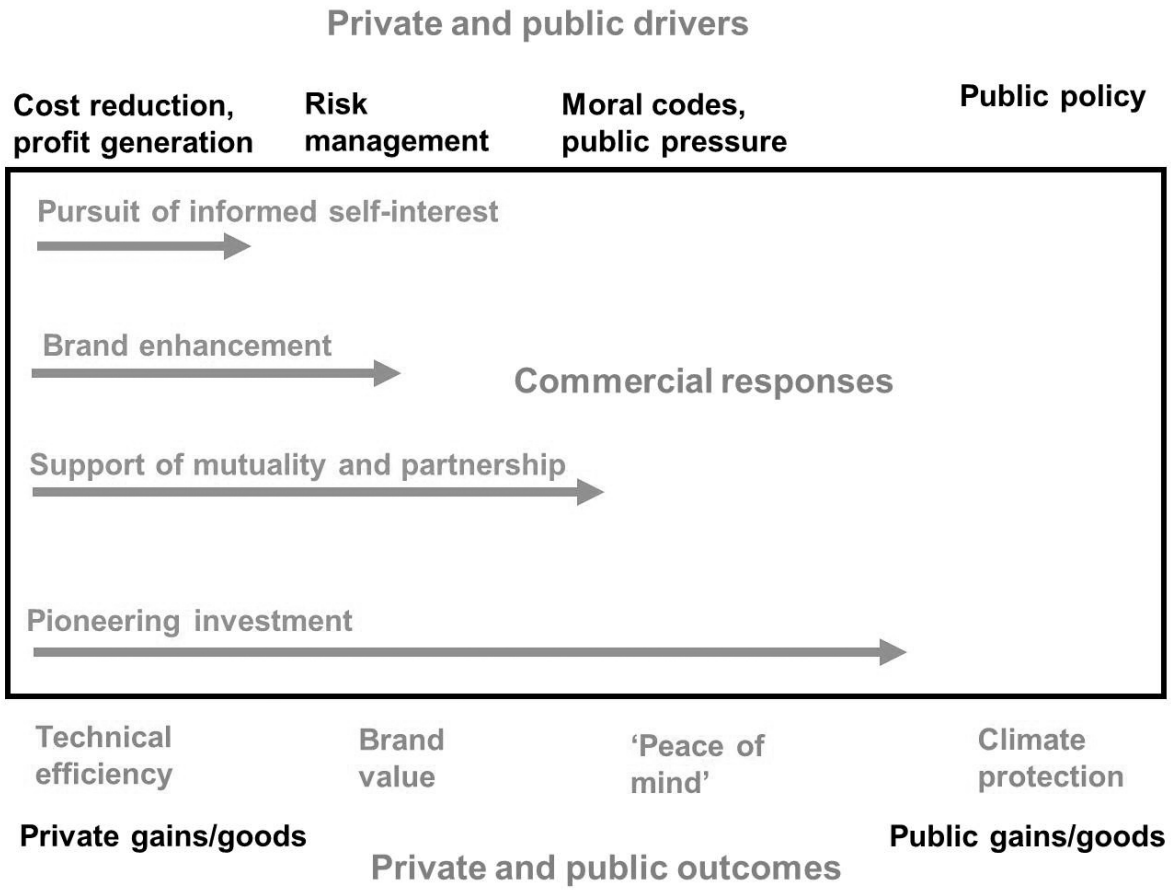

Figure 9: A schematic of external and internal drivers, firms' responses and outcomes governing the development and delivery of CR strategies relevant to GHG emissions.

All the firms in our sample pursue CR to the level justified by well-informed private interest. This is based on commercial motives of cost or direct commercial risk reduction. We observe that this is particularly common in Germany where firms have brigaded and framed their responses to local regulation, or the threat thereof, and their responses to subsidised renewable energy. The PHW Group factors the production of subsidised electricity from photovoltaic panels mounted on the farm buildings it uses into its CR position. It also highlights its use of biodiesel derived from the poultry fat arising in its processes. Similarly, Alfred Ritter GmbH is heavily focused on the use of renewable energy and energy conservation to the extent that the company is prepared to invest up to a point that involves 15% higher overall

energy costs at current prices. Investment in internal efficiencies in energy use which are cost-saving are particularly prominent in food manufacturers focused on 'local' raw materials such as dairy processors and companies such as Heinz and Barilla. The large retailers are also focused on internal energy efficiency.

CR efforts that go beyond internal efficiencies and responses to regulation can be largely justified by brand protection and enhancement. This includes the management of general reputational risks and the strategic positioning of brands to increase their value. Brand enhancement is the most obvious economic return arising from the use of certification. The major food manufacturers such as Nestle, Unilever, Kraft and Heinz all engage in supply chain management activities that are closely related to certification. Sourcing certified produce is not only a brand protection strategy, but is also justified by long-term security of supply of quality traceable produce.

A wide range of firms claim to strive for mutual benefits for several organisations in the value chain. They can be found in mutually-owned firms such as the Arla, Coop and John Lewis, but also in privately-owned firms such as Mars and Walmart. Mutuality and partnership is the foundation of pre-competitive investment in corporate climate responsibility. The framework for mutual cooperation to address pre-competitive targets in the food sector and set industry-wide standards is mostly based on (commodity) roundtables which partly also manage certification schemes. Targets addressed here are generally costly or impossible to implement for a single firm. These partnership activities are developing with different degrees of ambition with the Roundtable for Sustainable Palm Oil reaching a position where its members could collectively make a significant impact on land use in the major palm oil exporting countries. Another example is the Sustainable Agriculture Initiative which

provides a platform for 50 global food companies with a focus on arable and vegetables crops, beef, coffee, fruit, and water in agriculture. The initiative is strongest in the dairy sector where its members claim to be involved in 85% of global commercial milk production. Hence, if widespread and ambitious, these collective instruments can be powerful agents of change.

Beyond cross-firm collaboration, our analysis of the position of the firms in our sample indicates that while there is a lot being done by individual firms, few companies have worked with public policy to support regulation that would advance climate protection in a fundamental way. In 2006, the Brazilian Soy Producers Association (ABIOVE) and its member companies pledged not to trade soy originating from land cleared in the Amazon biome. This was extended for a further year in June 2008. The ABIOVE moratorium on unsustainable soy is a rare example of a successful quasi-regulatory approach and this underscores the need for cooperation with public policy. It has since been replaced by active support of Brazil's developing environmental regulations (ABIOVE 2014).

Pioneering investments have a pre-competitive character. A combination of firms' internal moral codes and external public pressure has driven the pioneering work of companies. We found many individual examples of pioneering pre-competitive activities by various firms but we found no firm or market characteristic that is correlated with pioneering investments. Some companies are developing sector-wide pre-competitive activities to advance public policy agendas. A range of food companies are involved in plant breeding which is generally an activity that is subject to significant market failure even if marketable improved varieties result. Marks & Spencer is a pioneer in its sector in launching Plan A which was regarded as partly pre-competitive at that time of launch.

6. Conclusions and recommendations for the agri-food sector

Stern's assessment (Stern 2006) sums up the fundamental challenge facing those seeking to reduce GHG emissions through CR: A stable climate is a global public good and GHG emissions have equal global impact regardless of origin or cause. It is hence difficult to justify private investment in mitigation, particularly for emissions that are not directly related to internal costs such as energy use. These 'non-energy' emissions are a particular feature of food production due to the dominance of emissions from carbon dioxide from land use change, and nitrous oxide and methane from the underlying biological processes in production. Despite this fundamental difficulty, our research shows a global agri-food sector in transformation with respect to CCR. Almost all of the firms we examined have introduced CCR activities. These efforts are still new, with many firms now reporting just the early phases of efforts to reduce GHG emissions. It is remarkable that the development of these strategies and activities continued during the global financial crisis of 2007 to 2010 when profits and share values of most publicly listed companies in the food sector dropped. From this and our examination of firms' strategy documents, we conclude that the drivers behind CCR are central to firms' strategies and not marginal or passing activities. Many current strategies set out plans to extend current activities. This growth is particularly clear in terms of the use of certified produce with targets to reach 100% by 2020 common. Similarly, reductions in energy use in operations of up to 20% by 2020 are also common.

Our analysis reveals a complex of drivers operating across the sector but few patterns in the responses of firms can be identified. Differences in commitment to activities cannot be attributed to ownership models or to the differences in policy on climate protection in the countries where firms are strongest or registered. Some firm

characteristics such as a high labour to capital ratio are associated with greater efforts. Examination of firms' documents confirms the view expressed by Becchetti et al (2013) that CR relevant to greenhouse gas emissions is strongly rooted in Anglo-American business culture.

While relatively new in the food sector, CCR has grown rapidly over the last decade, building largely on existing CR activities aimed at social and wider environmental outcomes. Our analysis reveals that while a lot is being done at appropriate points in the supply chain, this is by no means sufficient to achieve the far reaching change necessary to enable the agri-food sector to contribute proportionally to addressing the climate protection challenge. It is difficult to assess effects on emissions and to compare firms due to the many interacting processes and potential points of intervention. Generally, the sector concentrates on incremental improvements driven by cost-saving, supply chain security and brand enhancement. The majority of measures cover single products or processes as opposed to the whole business or entire supply chains. There are "win-wins" for investment in mitigation such as energy savings in most cases. Win-win measures are more likely to be adopted in CR schemes compared with measures with direct external benefits only, i.e. public goods provision. Far reaching changes by single firms are found in niche areas, such as the organic sector.

Another way of achieving radical change is through coordination and pre-competitive pioneering investment. There are some initial examples in particular in the commodity roundtables. However, this study shows that CR is not an alternative to public policy action. Governments ultimately bear the responsibility for levelling the competitive playing field and ensuring public welfare. In order for business to effectively mitigate emissions, government and the private sector must construct a

new understanding of the balance of public and private responsibility and develop new governance and business models for creating social value. Cross-sector pre-competitive collaboration including public policy can add to the incentives for climate-responsible supply chains and in particular add to disincentives for irresponsible production. The success of ABIOVE soy moratorium shows how this can work. Working together, the food industry operating at farm level and regulators can achieve a great deal to create advantage for responsible producers. CR strategies should place much greater emphasis in supporting the development and enforcement of regulation and public policy to support climate-responsible production.

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Appendix

Table A.1. List of available carbon standards (April 2013)

Type	Labels	Certification body	What it does	Focus in food sector
Carbon Intensity Label	Carbon Label	Carbon Trust Standard Company Limited	Only CO_2-analysis	Product
Carbon Neutral Label	Atmosfair	Stiftung Zukunftsfähigkeit	CO_2-analysis and CO_2-compensation	Transport
Carbon Neutral Label	TÜV NORD CERT	TÜV NORD CERT	CO_2-analysis, CO_2-reduction and CO_2-compensation	All parts of the supply chain
Carbon Neutral Label	CarbonFree Certified	Carbonfund.org Foundation	CO_2-analysis, CO_2-reduction and CO_2-compensation	Product
Carbon Neutral Label	Carbon*Free*® Partner programme/events	Carbonfund.org Foundation	CO_2-analysis and CO_2-compensation	Product
Carbon Neutral Label	Carbon Neutral	The CarbonNeutral Company	CO_2-analysis, CO_2-reduction and CO_2-compensation	All parts of the supply chain
Carbon Neutral Label	Climate neutral label	myclimate (Swiss foundation)	CO_2-analysis and CO_2-compensation	All parts of the supply chain
Carbon Neutral Label	Climate performance	myclimate (Swiss foundation)	CO_2-analysis, CO_2-reduction and CO_2-compensation	Firm
Carbon Neutral Label	CO_2 neutral production process (Provamel)	Provamel	CO_2-analysis, CO_2-reduction and CO_2-compensation	
Carbon Neutral Label	CO_2OL	Forest Finance Group	CO_2-analysis, CO_2-reduction and CO_2-compensation	Product
Carbon Neutral Label	Green Index rating		CO_2-analysis, CO_2-Reduction and CO_2-Compensation	
Carbon Neutral Label	KlimaINVEST	Investment company KlimaINVEST	CO_2-analysis, CO_2-reduction and CO_2-compensation	All parts of the supply chain
Carbon Neutral Label	NCOS Carbon Neutral Program (National Carbon Offset Standard)	Low Carbon Australia	CO_2-analysis, CO_2-reduction and CO_2-compensation	Firmfirm
Carbon Neutral Label	No CO_2 Certification Program	Carbon Reduction Institute	CO_2-analysis, CO_2-reduction and CO_2-compensation	All parts of the supply chain
Carbon Neutral Label	Stop Climate Change	AGRA-TEG Agrar- und Umwelttechnik GmbH Göttingen	CO_2-analysis, CO_2-reduction and CO_2-compensation	Firm
Carbon Neutral Label	SwissClimate "CO_2 Neutral"	Swiss Climate AG	CO_2-analysis, CO_2-reduction and CO_2-compensation	Firm

Carbon Neutral Label	Green Tick Certification "Carbon negative"	Green Tick Certification Limited	CO_2-analysis, CO_2-reduction and CO_2-compensation	Firm
Carbon Neutral Label	Green Tick Certification "Carbon neutral"	Green Tick Certification Limited	CO_2-analysis, CO_2-reduction and CO_2-compensation	Firm
Carbon Rating Label	Climatop	Climatop Association	Only CO_2-analysis	Firm
Carbon Reduction Label	Carbon Reduction Label	Carbon Trust Standard Company Limited	Only CO_2-analysis and CO_2-reduction	Product
Carbon Reduction Label	Carbon Trust Standard	Carbon Trust Standard Company Limited	Only CO_2-analysis and CO_2-reduction	Firm
Carbon Reduction Label	Climate certification for the food chain	KRAV Swedish Seal/Svenskt Sigill	Only CO_2-reduction	Product
Carbon Reduction Label	CO_2-certification according to the ABCERT-Standard	ABCERT AG	Only CO_2-analysis and CO_2-Reduction	All parts of the supply chain
Carbon Reduction Label	Soil & More	Soil & More International	Only CO_2-analysis and CO_2-Reduction	All parts of the supply chain
Carbon Reduction Label	SwissClimate " CO_2 optimized"	Swiss Climate AG	Only CO_2-analysis and CO_2-Reduction	Firm
Low Carbon Label	Corporate Carbon Footprint by TÜV NORD CERT	TÜV NORD CERT	Only CO_2-analysis	All parts of the supply chain
Low Carbon Label	SwissClimate " CO_2 footprint"	Swiss Climate AG	Only CO_2-analysis	Firm

Table A.2. Summary of direct GHG emission aims and achievements as reported by the firms in the study sample

Firm	Emission reduction aim	Period	Achievements (where reported)	Basis of measurement and scope of emissions
ABF			22% CO_2 emission reduction 2009/10	
ADM	15%	2010 - 2020	2010-2012: 2.6% reduction in emissions; 4.3% reduction in energy use.	Operating energy use and emissions on per unit of production
Alfred Ritter GmbH & Co. KG			6,800 tons GHG reductions yearly since 2002 through own energy production	
Arla Foods	25%	2005 - 2020		Operating emissions per unit milk
Barilla	55%			
Barry Callebaut			19% carbon emission reductions 2008 - 2011	Operating emissions per unit of production
Cargill	5%	2010-2015	4.9% reduction to 2012	Operating emissions (firm)
Coca-Cola	Zero growth in company emissions with output increasing	2004-2015	3% increase in 2011 compared to 2004	Operating emissions for the company (detailed analysis on transport, etc. level)
COOP	CO2 neutral by 2023, i.e. 50%	2008-2023	15% reduction from 2008-2012	direct and indirect emissions of operation the retail businesses (production in owned manufacturing companies, logistics, shops)
Danone	30%	2008-2012	35% reduction achieved	Company operating emissions
Del Monte	Processing 10%, transport 7%, packaging 11%	2007 - 2016 (2007 - 2011 packaging)	11% reduction in processing (2007-2011)	Company operating emissions
Ferrero	40%	2007 - 2020	12% reduction in per unit product emissions in 2010-2012	Company operating emissions
General Mills	20%	2005 - 2015	9% reduction in emissions per unit product	Company operating emissions
Glanbia	25%			Dairy supply chain
Gulpener Bier				
H.J. Heinz Company	20%	2005 - 2015		Direct emissions from operations

Hershey	13%	2009 – 2015	22% reduction 2009-2013, new target 15% (2013-2017), offset emissions for corporate and sales fleet in 2014	Company operating emissions
Hipp	Carbon neutrality		21% energy saving 1999-2011. Carbon neutrality achieved	
John Lewis Partnership (Waitrose)	15%	2010-2020	On target in 2012.	Company operating emissions
Kelloggs				
Klasmann Deilmann				
Kraft Foods				
Marks and Spencer	35%	2006/7 - 2012/15	All stores, offices and warehouses in the UK and Ireland were carbon neutral by 2012. Gross CO2e emissions down by 22% by 2012.	Company operating emissions
Mars	25% overall. Eliminate GHG emissions from factories & offices	2007-2015, 2040	5% between 2007 and 2011	
McCain Food	None, measurement			
McDonald's	"aspirational" goal 20% increase in energy efficiency	2013-2020		Energy from company operations by company-owned restaurants in top nine markets.
Morrisons	30%	2005 - 2020	15% reduction in operational emissions 2005 – 2011	Company operating emissions
Nestlé	35%	2005-2015	Emissions declined 24% during 2002 - 2012	Operating emissions per tonne of product
Peeze Coffee				
PepsiCo	Stable emissions with business growth			Total operating emissions
PHW group	50%	by 2020		Product life-cycle emissions
Provamel			Production process is carbon neutral since 2010	

Sainsbury's	30 % absolute 65 % relative 50 % in food carbon footprints	2005 - 2020	3.7 % absolute reduction from direct and indirect sources from 2010/11 to 2011/12; 48,000 tonnes of carbon since 2007 through Farmer Development Groups.	Operational carbon emissions – absolute and relative to output; own brand products
Starbucks				
Stora Enso	35%	2006-2025	Direct and indirect fossil CO_2 emissions from pulp paper and board production facilities reduced 26% from 2008-2012	Fossil CO_2 emissions per saleable tonne of pulp, paper and board
Sustainable Restaurant Association				
Tchibo	30%	by 2012	2006 to 2011: 30 % (transport, direct)	Transport emissions adjusted for sales and tonnage
Tesco	50% in buildings' emissions by 2020. Zero carbon for internal emissions by 2050	2006-2020	Generally on or ahead of energy and emission targets	Operational emissions
Unilever	Energy emissions in manufacturing: at or below 2008 levels Manufacturing: reduction of 40% per tonne of production.	2008-2020	32% 2008-2013 in manufacturing sites (manufacturing accounts for 5% of value chain emissions). the total GHG impacts including consumer use, has increased by 5% since 2010.	Energy in manufacturing, manufacturing Revision of strategy ongoing
Walmart	20%	2005-2012	13% absolute reduction in GHG emissions in 2005 base of stores, clubs and distribution centres	Applies to a specific subset of our facilities: base of existing stores, clubs and distribution centres