PERSPECTIVES ON DIETARY HABITS AND CARBON FOOTPRINT CONSUMER AWARENESS: A SURVEY OF CURRENT LITERATURE TOWARDS SUSTAINABLE CONSUMPTION

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NB.

Throughout this review, we shall use the word 'carbon' and its derivates as a short referring to all GHGs—CO_2, CH_4, N_2O and all others alike—, meaning more generally carbon dioxyde *equivalent*—$CO_2 e$—, that is, the mass of CO_2 that would have the same potential of global warming, when measured over 100 years, as any given mixture of greenhouse gases; and thus, 'carbon footprint' as that of the full impact our choices have on climate change. These shorts must therefore be borne in mind as such, for the share of CO_2 in food production induced GHGs is lower than the average for all sectors[82]—for meat, rightly blamed as the most GHGs-intensive, it is even actually virtually almost 0[128]—, and GHGs have very different warming potentials (see the IPCC's estimates: ⟨http://www.ipcc.ch/publications_and_data/ar4/wg1/en/tssts-2-5.html⟩ and ⟨http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html⟩). The same way, we shall consider a 'carbon label' any information provided as an indication of the global climate impact of food. 'GHGs', unless specified otherwise, always refer to anthropogenic, human activity-induced GHGs.

APPROACHES TO THE 'ECOLOGICAL PROBLEM' No actor of today's policy and economy-making can afford to ignore the new motto of the 'eco-responsibility'. On the one hand, it has become a marketplace of its own, where a growing number of producers try to appeal to a growing number of consumers wishing to 'shop ethical'. Be they still a limited number and small share, it is easily overlooked that 'firms respond to generalized concerns about brand reputation even if consumers only demonstrate limited willingness to pay for lower-carbon goods' (447: 5). On the other hand, it has become a standalone tool and target for policy-makers to address the ecological issues at stake, and is acquiring more and more legitimacy and binding normative importance.

But whilst the so-called 'green economy' is booming [1] and the political sphere slowly shows more and more concerns, the interactions between the economical and political trends in approaching environmental issues remain very unclear, and beyond much arguing and discussion, there does not exist a real 'Green Deal'. Common to all approaches concerned with addressing the environmental issues (deep modernization as well as deep ecology, ecological modernization, preservation thinking and the partisans of the 'green revolution') is the observation that purely economical measures are to no avail: suggested for some time by the Factor 4 plan, the mere halving of resources use can no longer be regarded as an option: while some recommend a tenfold increase in resource efficiency at least and equal decrease in GHGs emissions, (370: 240) it is well established that rebound effects condemn in advance any policy which would fail to address both demand and supply sides together: as Evans & Jackson (2008) point out, 'it is now widely recognised that "sustainable consumption" cannot be framed as a technical problem wherein levels of economic consumption (of goods and services) can remain the same or increase whilst efficiency gains in resource productivity (i.e. the consumption of material resources) provide the solution. Such a view [...] would equate sustainable consumption with sustainable production which in turn runs the risk of overlooking any potential rebound effects or the ways in which consumption is embedded in modern ways of living' (369: 5). And these have such an importance that it may well not be far from the truth to question whether the are any environmental benefits to energy efficiency altogether:[38–41] to use an economics image, there does not at all seem to be an energy-use Kuznets curve. While no solution is to be expected on the part of mere 'good will' and solely incentive measures; just as unthinkable is the opposite alternative of a dictatorial, state-controlled 'all-political green economy': if the blameworthy 'consumer society' undoubtedly needs reform, the path lies in a middle-way solution, that for policy-makers to both educate and influence both consumers and producers towards *sustainable consumption*.

DEFINING 'SUSTAINABILITY'; RECONSIDERING THE 'REAL WEALTH OF NATIONS' Sustainability has very many different definitions (up to 300![282]). Following Wackernagel (59, 2001: 1), we shall use the most simple and basic one, i.e. *avoiding ecological overshoot*. To not be irrelevant, other definitions are rather a matter of philosophy and political ecology: as far as GHGs emissions go, this definition covers the needs and stakes of the present study.

Considering what the 'cost of inaction' would be, [2] one can only join Sutton et a. (192, 2012) in calling our ability to map and monetize our ecological footprint 'the real wealth of nations'.

But whilst climate change can be regarded as the very most critical ecological issue to date and estimations of GHGs emissions evolution seem to always plead for greater pessimism, [3]

1. See below, The New Green Economy: factsheet (p. 37).
2. See e.g. 415 and other OECD studies.
3. In 2008, GHGs emissions were expected to grow by 52 % by 2050 (415: 25), and the latest IPCC work

GHGs are far beyond other considerations in the mind of consumers when they think of their environmental impact and try to mitigate their 'footprint'. In the minds of many, the 'carbon footprint' remains the one most difficult criteria to consider on a day-to-day basis: when it isn't disregarded altogether, it is seen as secondary, and to those who wish to take it into account, proper information lacks to lead proper action. To this day, apart from the UK, many developed countries like France still have no or hardly any proper carbon information or labelling policy.

Rather than contemplating ways of 'forcing' sustainability, this study aims at presenting Mike Berners-Lee's ambition: to give each and everyone a 'carbon instinct' (2010: 1) and the ability of making a 'reasonable guesstimate' of the carbon impact embedded in just about any of our consumption choices: assuming carbon works like money, he writes—and it has indeed become a real 'currency', Cranston and Hammond say (2012: 91), following Sutton et a.'s (2012) image that our ability to map our EF is 'the real wealth of nations'—, 'our carbon instinct must be just like the one we have for managing money,' and we should be able to tell our CF 'without looking at the price tag'. But there ends the comparison, for nobody gets a carbon bill, and therefore awareness and responsibility are not easy to raise. Nevertheless, should such diet-shift encouraging policies indeed be conducted, the first and main step to be taken would evidently be to conduct 'an inquiry into the relative importance of subsectors and the different stages in the life cycle of food as sources of GHGs emissions' (281: 21).

Notez la référence filée à Smith, je vous prie. Je me donne du mal…

'CONSUMPTION' AND 'CONSUMERISM'. THE IDEA BEYOND A SUSTAINABLE APPROACH TO CONSUMPTION PATTERNS Before going any further, many at this point would present an objection, as Evans & Jackson (2008: 6) rightly point out. Since 'consumption' is intuitively linked to 'growth', a first theoretical distinction must be made between *consumption* and *consumerism*:

> The starting point of our analysis is that there is a fundamental distinction to be drawn between consumption and consumerism. People often quip that 'sustainable consumption' is something of a contradiction in terms and it is not difficult to see why. For example, 20% of the world's population are using 80% of the earth's non-renewable resources and they are doing so by spending 86% of all the money that goes into personal consumption (UNDP, 1998) whilst recent estimates suggest that if everybody in the world were to consume (and concomitantly, pollute) at the same rate as persons living in Western Europe then we would need 3 planets to support us (WWF, 2004), 5 if we bring North America into the equation. However, this does not mean that consumption *per se* is inherently unsustainable

On the difference consumption/consumerism, see also 403, p. 33. Warnings on this issue regarding 'green trade': see 469

Other definitions of consumption have emerged than that of classical 'amended consumerism' [4]

Since attention was drawn to it at the 1992 Earth Summit and the Rio United Nations Conference on Environment and Development [5], sustainable consumption has gained more and more interest.[427] In 1997, Norman Myers called consumption the fourth of the usual, classic 'triad of problems' (population, environment and development), which 'in many respects […] could prove to be the least tractable of the four interlinked problems, since consumption patterns and expectations are deeply entrenched in most societies and cultures. However, change will come, whether by design or by default.'[403] In 2002 again in Johannesburg, it was

indicate even worst tendencies (see e.g. latest report, Summary for policy makers, fig. —.)

4. 391 e.g., quoted in 369.

5. 'the major cause of the continued deterioration of the global environment is the unsustainable pattern of consumption and production, particularly in industrialized countries' (439, Programme Areas, A, § 3).

generally agreed that current consumption patterns would reach their limits, [6] and two of the discussed points were 'running public campaigns on good consumption practices and energy' and 'paying greater attention to pricing policies as a means of enforcing more sustainable consumption patterns' (440: 5) and in 1998 the United Nations Development Programme's *Human Development Report* emphasized the need for and role of providing information whilst pointing that 'the links between consumption and human development are clearly neither automatic nor always positive' (441: resp. 43 & 45). More recently, the EU established that 'food (particularly meat and dairy), mobility and housing including energy using products [caused] over 70% of life [cycle] environmental impacts related to final household consumption expenditure in the EU'.[195, 196, 198]

The three stages of 'consumptionomics'. — Within this middle-way, several levels of action and options exist and, in order to be effective, policies must reach all three levels of consumers decision-making:[266] *information* for an optimal conceptual grasp of what the need to change is, *willingness* to do this change and *ability*, i.e. access to sufficiently accessible alternatives[410] for each of which levels correspond several sets of *regulatory*, *economic* and *social* policy tools.

If the modalities and features of this emerging choice factor are yet to be determined, it leaves no doubt that we have entered an new 'era of "consumptionomics"' [7] which, in linking buying choices to their environmental impact goes and needs to go far beyond mere 'marketing'. As Simon Upton, Director of Environment at the OECD, introduces in the OECD's (2011) main survey on the question, 'the most important lesson from the study is that there is wide variation across households in terms of underlying environmental norms', and that is specifically true of dietary ideas.

THE CASE OF FOOD AND DIETARY HABITS. A DOUBLE CHALLENGE Within this new discipline, food has a prominent role—mixing environmental and ethical issues, many call for 'food revolutions,'[402], [8] the 'real green revolution,' being a 'new ecological modernisation of agriculture,'[393] claim that 'your diet can help save your life and the world'; [8] some say we'd do no less than 'save or doom the world while eating', [9] that 'you can't be a meat-eating environmentalist' [10], that we are 'cooking up a storm,'[383] need to 'meat the truth' [11] and Jeremy Rifkin goes as far as to portray meat consumption as 'a new form of human evil, with consequences possibly far greater and longer lasting than any past wrongdoing inflicted by men against their fellow human beings.' [12] Which of these—if any—is the right formula to go about the issue is not for us to debate; but the idea that 'diet matters'[120]—that 'diet really does matter'[201]—does rely on compelling scientific observations and should without a doubt be regarded as a major, key environmental policy issue.[197, 351] But the challenges ahead are several, and as McMichael et a. (2007) remind, 'today, relations between energy, food, and health have become complex and multifaceted, raising serious policy concerns at national and international levels.' (153: 1). Understanding the complexity and different variables of the

6. 'our current unsustainable patterns of production and consumption are incompatible with a sustainable future' (440: Executive summary, p. 1).

7. NAIR Chandran (2011), *Consumptionomics: Asia's Role in Reshaping Capitalism and Saving the Planet*. Oxford: John Wiley & Sons.

8. ROBBINS John, *The Food Revolution: How Your Diet Can Help Save Your Life and the World* (Conari Press, 2010), and ⟨http://www.foodrevolution.org/⟩.

9. ⟨http://climatechange.thinkaboutit.eu/think4/post/food_and_climate_change/⟩.

10. ⟨http://www.huffingtonpost.com/ingrid-newkirk/you-cant-be-a-meat-eating_b_546969.html⟩.

11. ⟨http://www.meatthetruth.com/⟩.

12. 'There's a Bone to Pick With Meat Eaters', *Los Angeles Times*, May 27th, 2002, ⟨http://articles.latimes.com/2002/may/27/opinion/oe-rifkin27⟩.

'food issue' is an important and mandatory step on the way towards sustainability, but it is by no means an easy task.

It is week known and established that intensive agricultural practices have, over the past decades, tremendously increased the pressure on the environment, on many levels and in many aspects, causing eutrophication, acidification, etc.[178]:

> The doubling of agricultural food production during the past 35 years, David Tilman warned in 1999, was associated with a 6.87-fold increase in nitrogen fertilization, a 3.48-fold increase in phosphorus fertilization, a 1.68-fold increase in the amount of irrigated cropland, and a 1.1-fold increase in land in cultivation. Based on a simple linear extension of past trends, the anticipated next doubling of global food production would be associated with approximately 3-fold increases in nitrogen and phosphorus fertilization rates, a doubling of the irrigated land area, and an 18% increase in cropland. These projected changes would have dramatic impacts on the diversity, composition, and functioning of the remaining natural ecosystems [...] and on their ability to provide society with a variety of essential ecosystem services. *(193: 5995.)*

Arnold Tukker et a.'s studies[197, 198] estimated food to drive 27% of the impacts of total EU households consumption (198: 1783) and a growing number of research work has added up over the past years focusing on the issue of the sustainability of food chains (see p. 22 *sq.* and sec. 3 of References).

The most recent studies have shown, for the UK, total food consumption for 2009 to represent 27 % of the country's GHGs emissions and 19 % of the total GHGs emitted including embodied emissions from supply chains abroad.[239] In France, the government estimated these emissions to 12 %,[424] and 2.2t $CO_2e{\cdot}y^{-1}{\cdot}inhan.^{-1}$, including supply chains, of the 12t of total consumption emissions. [13] And not all diets have the same environmental impact. When, for the same provided energy, embedded emissions vary from 1 to more than 60, and 1 to 30 for protein-rich foods,[83] indeed *much* can be done towards an environmentally lighter production, and realistic dietary choices can help reduce significantly our GHGs emissions.[69, 83, 92, 100, 120, 124, 152, 153, 174, 186, 197, 198, 206, 237, 239, 284, 451] Many authors have come to consider that diet changes no longer stand among mere 'options' for sustainability, but rather as major issues, if not absolute and urgent imperatives.[69, 120, 153] As one of the OECD's *Environmental Outlook* red lights, the food sector is very far beyond what should be expected of it (415: 51 *sq.*) in the fight to obtain a 50 to 80% reduction in global GHGs emissions by 2050, as advised by the IPCC and a declarative goal for many European governments.

The challenge ahead is here a double one, both quantitative and qualitative:

1. purely quantitatively, food consumption is going to rise to keep up with the world's population increase:[124, 193] in order to avoid the 'looming land scarcity,'[138] 'all means to improve nutrition, especially for the poor, will be needed as population increases. One such means is to improve diets of the rich by eating lower down the food chain', Goodland writes: we have come to a point where 'we have let the world become so full that there is unfortunately already a trade-off between human numbers and diet [...] the necessary tripling of food consumption over the next 50 years will need all conceivable help it can get; time is short' (120: 190 & 191);
2. as linked to a defined revenue level: 'food consumption is also driven by rising per capita incomes. Global per capita food consumption (kcal/person/day) is projected to rise to 3 050 kcal in 2030, compared to 2 800 for 1997-99', the OECD deems (415: 51; 416: 120) and it is well documented that people tend, as their revenue increases, to consume

13. Quoted in 423, for 2007.

> not only more but also carbon-heavier foodstuffs, especially meat, and which come from further and further as the food chains globalize. (In France, food is, with transport, the only factor of GHGs increasing its emissions.[423])

In such a context, of the three possible ways of increasing food production (extensification, intensification, decrease grain-fed meat), 'none is encouraging,' Goodland notes (120: 191): reason why diet shifts are of such tremendous importance.

ADDRESSING THE DEMAND-SIDE ISSUE OF DIETS WITHIN LIBERAL ECONOMIES In a market-driven society, demand-side management is essential, Goodland noted already, and sustainability 'will be impossible unless the demand side also is stabilized' (120: 190 & quote p. 195), for it is first and foremost 'up to the consumer' to push for such shifts and 'buycott' the right products:[191, 445]

> The food preferences of the consumers and their budget for food items increasingly drive production in terms of how much and what kinds of food items that are produced [...] Changes in consumers' food preferences will thus have significant consequences for resource utilization. Anticipated and new preferences will be strong signals to the resource managers of how to allocate resources, where investments are warranted, where the risks and opportunities are, etc. [...] A delicate question is the following: are consumer preferences for different kinds of food articles and the forces that determine these preferences, leading to the 'best possible choice' in terms of nutritional security for the consumer? And do consumer preferences stimulate the production of such food articles that are environmentally most adequate? [...] policy for food security should be directed both to producers and to consumers. Incentives and sanctions that can be designed for the producers should be supplemented with measures that influence consumers in terms of what food items are most desirable from a resource and environmental point of view and also from a public health perspective *(191.)*

But the consumers awareness of different diets' environmental impacts is far from being as developed as it ought to be, nor is it always based on the most reliable notions and attitudes, and beyond information, the need for actual incentives is unquestionable to whom seeks an efficient environmental food policy.

SUSTAINABLE DIETS: FROM CURRENT DOMINANT NOTIONS AND PRACTICES TO ACTUAL ISSUES Notwithstanding the general need for a more responsible economy, the wish for environmentally 'responsible' foodstuff does evidently already exist on the food market, through the so-called 'green market', and stands very much by itself. 'A variety of labels also have been deployed to identify products as "organic," "fair trade," "biodiversity friendly," "sustainable," and so on, and organizations have formed to manage the label development, certification and verification processes' and up to '"dolphin-safe" tuna labels,' Vandenberg et a. note (447: 5), of which 'organic' labels hold a very large share. The OECD's *Environmental Outlook* called this trend a 'green light' (415: 54), and as far as the 'trend goes', one can only agree. But looking at the actual market and actual issues, here lie two important problems.

A first—and somewhat obvious—problem is that this green market only represents a tiny share of the global market, albeit fast growing, and if not likely to remain as small as now forever, is very likely to never reach further than a 'remainder' of the global market (its actual and potential customers seeking environmental information by themselves, responding to subjective incentives which are particular social constructs, and do not apply to 'normal' economy—the 'green usual suspects').

A second problem is that whatever the 'best intentions' of its customers, this 'green market' sustains itself rather 'egoistically,' one could say:

1. either as a component or synonym of a *healthy* diet—the thought being: 'that which is closest to Nature must be closest to *my* (physical) "nature", too';
2. or responding to a humanly *ethical* purchase—the thought being 'that which is closest to my (human) nature'.

Not to go into the detail of how logical and rigorous these approaches turn out in practice, [14] the point is that either way, the current notion of 'responsible consumption' *is by no means satisfactory as a 'good option' from an environmental point of view* (i.e., again, up to the *actual* most urgent environmental needs),[69] because it fails to address some key environmental issues as such. True, 'within the same dietary pattern, chemical–conventional production methods have a greater environmental impact than organic methods,' Baroni et al. (2006) write; but the motto of 'organic consumption' hardly ever relies on the key criteria which should be GHGs emissions, but rather focuses on eminently subjective notions, and those consumers seeking human and environmental righteousness still fall prey, by lack of proper information, to marketing ideas which though not necessarily bad hardly ever embody true environmental rationality. Not only is mere compassion for environmental issues not always followed by facts nor truly adjusted behaviours,[282, 286] but the common notions such feelings carry are not necessarily relevant in addressing the issue, and when they are, it is often more because they *coincide* with better practices than because they are best by themselves. As we will see, the very common belief that 'local food is best', for instance, is not at all necessarily true,[98, 113] but it is one amongst many.

À traiter: 129, 291

Hence not only are the current dominant notions of eco-responsability often flawed or at the very least reductive ones, but they may well also constitute an obstacle on the way to an *actually* sustainable consumption, for whilst not helping much in meeting today's demands, they somewhat help veiling other critical issues, because they fill the consumers imaginary with inadapted criteria.

Of course 'organic' or 'fair-trade' approaches to food purchasing and carbonic sustainability in food chains need no oppose each other, and can very much go hand in hand, but a truly effective approach *must* bear in mind that they need not always add up. They may take part in a 'small steps' approach to a critical approach to diets which may be quite effective on the long-run (10: 105), but it is now time to aim at building an *actual, real* notion of environmental sustainability: half the French thus still reduce environmentally sustainable diet to just 'avoiding waste', or buying local.[424] If the first is mathematically evident, the second isn't that obvious, and altogether reducing sustainability to avoiding waste isn't the right scale to tackle GHGs issues.

Carbon labelling policies do have emerged, or are currently emerging and developing.[253] But they are to the 'green market' what the green market remains to the entire economy, i.e. much insufficient; and likely to remain so as they are not backed by policy measures to generalize such informational schemes, nor used to actually reshape current food chains towards greener practices.

BEYOND 'GOOD WILL' AND UNCERTAIN INFORMATION: POLICY PERSPECTIVES TO MAKE THINGS EFFECTIVE Behind these issues lies another, subsequent question, namely whether a responsible policy can afford to rely solely and labelling and communication measures, or would be

14. 'Ethicists try to interpret people's behavior, but people often are neither strictly logical nor consistent in their diets,' Goodland notes, whilst emphasizing the positive perspectives left open by flexibility (120: 196).

compelled to establish arbitrary tolls to make up for consumers' and producers' insufficient adaptative tools. So far we have only considered policies dealing with information and willingness, which could—in theory at least—rely on mere information campaigns and 'soft' labelling measures imposed on producers. So far, this is also the main discourse in current policy: 'the United Nations Environment Programme (2005) has addressed the use of communication campaigns and marketing strategies to motivate sustainable consumption and sustainable lifestyles whilst in the UK, the Department of Food, Rural Affairs and Environment [...] draws heavily on social psychology and the mantra of behaviour change in its sustainable production and consumption research programme'[369]

Here again lie two problems. First as Vandenbergh and Steinemann (2007) have shown, 'individual behaviors [...] are resistant to change, even when the change is rational;' that is why real social change in dietary practices cannot be achieved only though informational incentives, and the 'first step', that of providing truly relevant information (without relying on often flawed marketing mottos) is going to need more than just labelling.

Second, assuming it ever did, buying 'green, fair and healthy' is not enough, and well designed greens shops do not help meeting the final most undermining issue on the path to transition towards sustainability: the mere *economic ability* of all consumers to adapt their dietary behaviour. When it does not lack effectiveness (because of poorly understood or insufficient criteria and goals, or a too small share of the entire market), it lacks *extension*, both because

1. it does not reach key products to which it would be economically prejudicial, and
2. it cannot reach certain consumers to which economic incentives do not allow such purchase, either because they can't afford to rely on more than price, or simply would not care despite being provided quality information.

Whatever informed and willing up to what is needed, not all can afford nor are all willing to adopt a sustainable diet, reason why policies must also consist of normative binding and economically constraining measures, sufficiently powerful to 'internalize the externalities' to a point at which carbon-low products are made affordable to all, and carbon-high products comparatively less economically attractive.

The way to go about it raises then again delicate and complicated issues: how to make such measures both *fair* and *effective*? Through tax or pricing measures, the revenue taken from high-carbon products being then redistributed as to make low-carbon equivalent products accessible to low-income consumers? Through a generalized carbon allowance, on the model of current carbon trading in industry? Whatever the answer, the need is clear to *price* carbon footprint and go beyond good will and good information.

ECOLOGICAL RESPONSABILITY, HEALTH POLICY AND SOCIAL JUSTICE. FROM A BIG DEAL TO A GREAT DEAL? Linked to all these questions also lies a major *health* concern, but the question we ask here is very different from the one currently behind most 'green buyers.' If the 'best effectiveness' theoretical frames in addressing environmental issues suggest our starting from food chains to go towards diets, we then need to ask whether eating *ecologically* well can be synonymous with eating healthily. If such were not the case, an additional trade-off would have to be debated; but most studies indicate it is:[120, 149, 150, 153, 198, 211, 267, 284, 322, 337, 346, 353] working with food from day one means addressing obesity and all kind of illnesses, and political consensuses do exist on healthier diets agendas [15] just as much as environmental issues—another reason for public policy makers to take action. 'Enlightened policy responses would both benefit health and enhance sustainability,' McMichael et a. (2007) write. As it is,

15. On the links between diseases and dietary practices, see especially 198, Tables 2 & 3 p. 1778.

both are so 'well' connected that health-oriented measures are the only ones which have been considered, in the EU, as directly applicable to address *both* health and environment-related dietary issues.[198] Should there be no environmental benefit to be taken from dietary shifts whatsoever, 'alternative diets [offering] the benefits of a large scale reduction of obesity[,] diabetes, cardiovascular diseases or even cancer are sufficient justification in itself' towards diets which also are more environment-friendly, as Tukker et a. write (198: 1785).

But as Goodland's original article pointed out (120: 190), the reasons for a diet policy are at least fivefold. The first point has much changed since Goodland published his article, but the point outside of academia hasn't: food is currently not regarded as an environmental issue, and this is bound to urgently changing or causing tremendous ecological damage. Second, diet is a poverty and equity issue. As we will see, those diets demanding and damaging the more ecological resources are those of the rich, and as they grow and generalize, they seriously threaten the global ability to food sustainability, especially for the poorest on the planet. Third, and although it has now become a 'hot topic,' there is little agreement on what constitutes agricultural sustainability, and how to get there. Fourth, as we have seen, it stands among the most polluting sector overall, and most certainly the first in terms of global depletion to date: 'agriculture has degraded more natural capital and caused more extinctions of species than any other sector [...] expansion of food supply under any scenario makes the environmental impact of agriculture one of the most urgent and under-addressed predicaments of our times', and fifth, 'within agriculture, the case to demote cattle on the development, environmental, health and poverty alleviation agendas is strong and intensifying' (120: 190).

THE TRIPLE CHALLENGE OF A FOOD SUSTAINABILITY POLICY The challenge of a sustainable consumption policy is therefore a triple one:

1. on the buyer's side: how to raise a true, reliable and effective awareness resulting in behaviour changes up to those needed? In a word, how to go from dietary behaviours to behavioural diets?
2. on the producers side: how to track, calculate and display the full carbon/ecological footprint of any product put on the market? In so doing, one must bear in mind both
   (a) the environmental impact of production (what we shall refer to, in short, as 'agriculture')
   (b) that of the subsequent transportation, transformation and conditioning all the way to our plates ('farm to fork' or 'cradle to grave' studies).

   In both cases the supply chain must be considered *globally*, as to not just delocalize emissions to other countries or activities (which often results in a global *increase*).
3. on the global economy scale: how to give consumers the ability of such a dietary shift towards sustainable consumption, and for those to whom, despite information and ability, willingness would lack, how to use economic measures to force the global food market system to adapt and *integrate* within itself the demands and sustainability.

   Within such policies, two categories of measures can then be identified:
   (a) those addressing *all consumers* (e.g. general taxation, personal carbon allowances)
   (b) those addressing *certain categories* of goods and foodstuffs, specifically identified as *too* environmentally costly.

   In both cases we must then ask how to reach the best effectiveness/fairness mix—or trade-off—: if taxes are to be decided, should they be progressive? what threshold should be defined?

AXES OF THE PRESENT REVIEW These questions are of concern to an incredibly large number of disciplines[10,303,455] and fields of study, from history, anthropology, sociology, geography,[277] to, more obviously, economics, politics and ecology.

We shall here review, as broadly as possible within the limits of concision, the state of the art, spoken positions, controversies and remaining open questions on:

1. what determinants account for current dietary choices (i.e. what economic and social attitudes matter; convoking history, social and behavioural sciences as well as 'classical' economic theory);
2. whether, and if yes how policy makers can indeed push for a more responsible consumption behaviour; and more specifically:
   (a) to what extent can consumers be made more carbon-aware and willing to adapt?
   (b) what and how can measures and labelling policies be, in practice, implemented?
3. what policies can be contemplated to go beyond information and communication measures, and internalize environmental and CF of food within the food supply chain and current food market.

Transversally, we shall consider what implications this whole issue has, amongst others, on the evolution of international trade and cooperation, towards a sustainable, healthy and fair food future.

1 Prologue: determinants and factors affecting dietary choices and behaviours. Understanding the problem of modern diets

We do not seek here to provide an overview of the 'global food stream' nor of its global trends, but rather highlight the patterns and some evolutions in dietary behaviour and ponder their reasons, meanings and implications to better understand how policies can take place and bring along the change needed.

'FOOD IS EVERYWHERE POLITICAL' write Watson and Caldwell (2005: 3). If 'our diets have changed beyond recognition in the past 50 years', as introduces a FOE briefing on sustainable diets,[268] 'consumer decision making in all times was driven by taste'[266] and, of course, taste itself is defined by social, political and economic consumer preferences. We know for instance that just like meat consumption *per capita* has doubled over the past 50 years (which taking into account demographic growth means a five-fold increase in meat production), 'the more recent generation spend three times less money to buy fresh fruits than the generation born between 1937 and 1946'.[10] This means these habits can now too be modified and altered towards better practices.

RÉFÉRENCER. RENVOYER À FIGURE IDOINE

1.1 Declining food prices, higher productivity, enhanced availability… and as many rebound effects

All in all, the entire 'food issue' could actually in all rigour be called one big collection of rebound effects: from scarcity to abundance—and overuse—, from high prices to fast- and cheap-food, from under-productivity to overly intensive measures depleting croplands and the global environment… All policy and societal practices; meaning that 1, the issue cannot be solved through mere technical measures, and 2, that diffusing information is no sufficient incentive to translate knowledge into dietary habits.

Less predictable, less coherent diets. — Against the common idea, today's consumers are much less predictable and 'coherent' than they used to be, Céline Laisney (2012: 1) explains for the case of France:

> nous allons vers un éclatement des modèles, une « polyalimentation » où […] les pratiques les plus opposées, parfois même les plus contradictoires (industrielles, éco-labellisées, médicales, éthiques, gastronomiques, etc.) coexistent, réfractant ainsi une société elle-même de plus en plus composite. *(18: 3.)*

Today's 'dietary behaviours are formed by considerations that are not all connected with food and nutrition *per se*', continues Patrick Etiévant (2012: 103): an effective policy should aim at inverting this state of fact. We shall review here the determinants of current food consumption patterns, to better understand how policy can effectively take action, bringing tomorrow's consumption from dietary behaviours to behavioural diets *(section 3)*.

266: Time constraints usually cause more environmentally harmuful dietary choices.

Urbanization of dietary patterns. — It is well established that rural dietary patterns are less healthy than those of urban populations.[153] 'the food preferences amongst the urban

population is much more dynamic and influenced by several factors as compared to the corresponding preferences amongst rural population, i.e. those who produce the food':[191] the distance between production and consumption tends to cause blindness towards the consequences of production.

Globalization of food chains and food habits. — 'A new McDonald's restaurant opened somewhere in the world every 8 hours during the mid-1990s', and every six days in France in 2003. (29: 2 & note 2)

There exist old but growing concerns about the 'McGoulagiszation'[19] and the 'McDonaldization of Society'[54] in tomorrow's food world, whilst these recent dietary habits are more and more no longer seen as 'foreign' (and hence, somewhat barbaric), as they may have been in the past. [16]

Declining food budgets: reasons and implications. — The 'food' share of the average French household has decreased significantly since the 1970s *(see Fig. 1)*

> The usual expectation is that the prices of high-demand foods will rise while those with low demand will fall. Such a scenario is often true for seasonal fruits, which are expensive early in the season, but cheaper later. However, recent trends for energy-dense foods such as vegetable oils and high-sugar soft drinks show a trend in the opposite direction: as demand rises, their prices drop because of economies of scale achieved by the greater volume of production. *(153: 5.)*

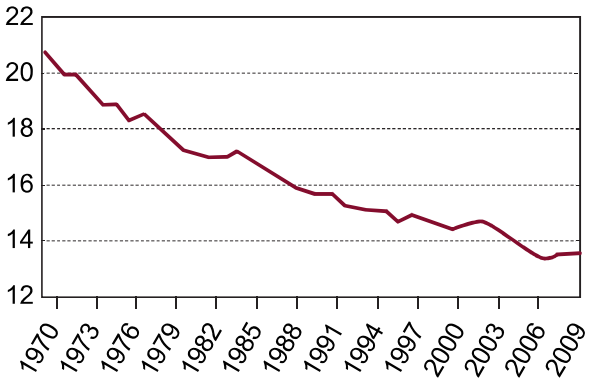

Figure 1 – Laisney (2012: 5), Graph. 1:
Poids (%) de l'alimentation dans le budget des ménages français (data INSEE)

UNDERSTANDING THE COSTS OF PROGRESS. DESPITE ENHANCED PRODUCTIVITY, THE GROWING ENVIRONMENTAL IMPACT OF FOOD CHAINS Of all 'ecological services' provided and ecological impacts of human activity, the greatest, whether considering water and land use, biomass appropriation or global nitrogen and phosphorus cycles, is that of agricultural food chains; with an equally important reliance of food production upon land: according to the FAO, in 2005, 'more than 90% of all food calories and approximately 80% of all food protein and fats available

16. See M. Caldwell's (2004) analysis for the case of McDonald's in Russia.

in the world were derived from croplands' (q. b. 133: 6868). Logic dictates that enhanced agricultural productivity should result in decreased land and natural resources requirements, and eventually a decrease in global environmental damage. But as prices and budgets have gone down in parallel, many rebound effects on the consumers' side have compensated these benefits, causing an increase in protein-rich food through diets shifts.

CONTRIBUTIONS TO LAND USE IN EVOLUTION Tukker et a. (2011) have thus shown quite striking differences between diets in the EU: identifying five clusters using FAO data, they have shown that for very similar diets energetically, Finland, France, Denmark and Sweden's alimentary energy relied on animal products up to 36.6%, whereas Bulgaria, Romania, Greece and Italy only got a 24.6% figure (198: table 1 p. 1778, after their 2009 work [197]). Globally, figures show a ten-fold variation in consumption of meat, and despite more and more globalized food chains, considerable differences and variations in diets remain between countries.[153] Needless to say, such differences cause as importantly different GHGs emissions; although animal products are not the only category to have important carbonic impacts and many other foodstuffs and agricultural practices must be taken into account. The same way, Thomas Kastner, Maria J. I. Rivasa, Wolfgang Kochc and Sanderine Nonhebela (133, 2012), using FAO data over a 46 years period (1969–2007), have shown that of the three factors of land requirement for agriculture—changes in population, agricultural technology, and diet—, 'potential land savings through yield increases were offset by a combination of population growth and dietary change' but that while the increase altogether, the data 'indicate an inverse relationship between the two main drivers behind increased land requirements for food: with socioeconomic development, population growth decreases and, at the same time, diets become richer. In many regions, dietary change may override population growth as major driver behind land requirements for food in the near future' (133: 6868). Over the considered period, 'the contribution of population declined while the impact of dietary change increased: dietary change contributed 24.6% to the sum of the impacts of diet and population change from 1963 to 1984; this value increased to 28.1% from 1984 to 2005' (133: 6870).

THE KEY ROLE OF DIETS SHIFTS Beyond a 'continuous increase in the average availability of food calories per person during recent decades (from approximately 2,250 to approximately 2,750 kcal/person/d)' (133: 6868), diet shifts have caused that 'the share of cereals in the food supply was decreasing throughout the developing world', while meat consumption increased *(see Fig. 3)*, causing, regardless of technical improvements in agriculture, a significant global *increase* in relative land requirements *(see Fig. 2)*, as well as environmental impacts. On the global scale, the croplands used for cereals, accounting for 40% of land use in 1963, dropped to 31% until 2005, whereas over the same period, that of animal products went from 35% to 38% and vegetable oils from 6 to 10% (133: 6869). 'Rates of decrease were different and developments were often nonlinear' of course, but beyond these average values, the diet shifts were a main driver to the evolution of global land requirements. Thus on the one hand, regions like Southern Asia and Eastern Europe, while undergoing important enhancements in their land use productivity, had a limited dietary change; [17] 'by contrast, hardly any decline occurred in Southern Europe and Eastern Asia, regions characterized by rapid dietary change'.

As Kastner et a. conclude, on the global scale,

17. 'In most regions, during the second half of the study period, the contribution of the population growth to changing land requirements declined while the contribution of the dietary change increased. Our results also show developments in the opposite direction. In Eastern Europe, after the fall of communism, per capita income levels declined and dietary change contributed to lower overall land requirements. (133:6871.)

> between 1963 and 2005, a 30% increase, from approximately 840 to 1,100 Mha of cropland harvested, could be observed. This was mostly driven by growing land demand for animal products, which accounted for almost 50% of the total increase. Vegetable oils, vegetables, and fruits follow, contributing 20%, 12%, and 9%, respectively. These three categories also exhibited the largest relative increase during the study period, with 2005 levels more than twice as high as those in 1963. […] At the global scale, the technology improvements were not sufficient to compensate for increases in population and changes in diets: global cropland requirements for food increased by approximately 270 Mha, or one fourth of the 2005 value, from 1963 to 2005. *(133: 6869–6870.) (see Fig. 5)*

ROOM FOR LOCAL IMPROVEMENTS, BUT UNVIABILITY OF GLOBALIZED WESTERN DIETS Much remains to be expected and done from technical improvements of agricultural practices. If food provision depends on global income, there is no evident link between global income and land requirement. Thus

> cropland demand for food *per capita* in much of Africa was in the same range as in Western Europe (approximately 2,000 m^2/person/y). These similarities in land requirements can be explained by large differences in output per unit land, while, at the same time, the diets of these two regions represent two extremes of the global spectrum. *(133: 6870.)*

Therefore, while much can be achieved through enhanced agricultural practices, the Western diet is not viable on a global scale: 'the sum of animal products, stimulants, alcoholic beverages, and vegetable oils accounted for approximately 75% to 80% of land requirements throughout Europe and North America [while] for the poorest regions of Eastern, Middle, and Western Africa, the corresponding value for these four categories was 25%' (133: 6869), levels at which no agricultural improvement is globally viable in terms of land use:

> Although variability in climate and land quality may explain part of the difference, the findings indicate ample space for improvements in the average nutritional situation without increasing (*per capita*) land demand. However, there is no indication that the present rich Western diets with the most efficient production techniques will lead to land savings. Supplying the projected global population of more than 9 billion people in 2050 with the present diet and agricultural technology of Northern America would mean that cropland area had to be almost doubled; using Western Europe as a reference would still lead to an area expansion by more than 70%. Compared with an actual increase of approximately 30% during the past four and a half decades, this would imply tremendous additional pressures on the planet's resources. *(133: 6870.)*

> Until now, increasing global population numbers were the major driver behind increasing land use for food. However, projections on the stabilization of global population levels in the near future cannot be translated directly into prognoses on the stabilization of pressures on land resources needed for the provision of food. Ongoing dietary change will put considerable additional claims on these resources. To give an example, feeding 9 billion people with current Western diets produced with current Western technologies implies the need for almost twice the presently used cropland area. *(133: 6871.)*

Robert Goodland (2011) too, has called attention upon the unviability of Western diets and the danger of their rapid diffusion, in China notably. Additionally, he argued in 1997,

the 'limited scope for improving food supply and what scope there is will further damage the environment' (120: 189). How 'little' the scope is shall be debated, but no doubt is to be had over the merely intensive enhancing of agriculture in terms of environmental damage.

1.2 Use and usefulness of information in dietary choices

'People generally and openly display extreme reluctance to change their eating habits,' Baroni et a. write (69: 5), and if social constructs are the main driver of dietary choices, information is bound to being secondary. As Etéviant introduces,

> Generic nutritional information and prevention campaigns have little short-term impact on behaviour when used alone. Nationwide information campaigns reach first and foremost the social groups already aware of the link between diet and health. For the same reasons, nutritional labelling has little impact, and is used mostly by educated or nutrition-conscious people. The technical information that is marked on labels is rarely used by consumers, who are not always able to take advantage of it and whose attitudes concerning food fall into simple categories: good or bad, healthy or unhealthy. Awareness of nutritional messages and their application do not generally lead immediately to the desired changes in behaviour. Over a longer time scale, changes in the behaviour of the wealthy, induced by preventive campaigns, may filter down into other strata of society through adoption of the culturally more appealing model. *(10: p. 104–105.)*

INFORMATION AND AVAILABILITY. THE IMPORTANCE OF ACTING EARLY Information moreover seems to only reach action when stimulated by availability, as it has been established in schools,[10,25] and dietary preferences, after they have been set at an early age, are more difficult to alter (the relative importance of adolescence being temporary, and often overestimated except in cases of accentuation of previous bad habits) (10: 106).

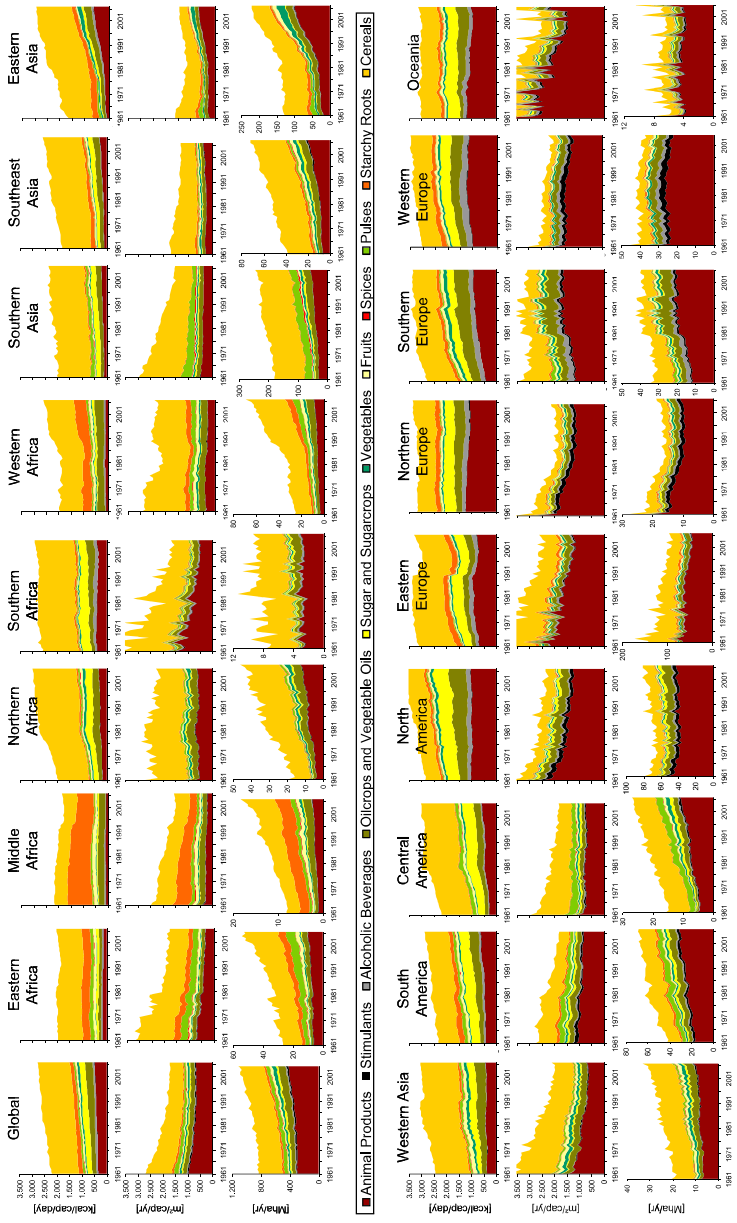

Figure 2 – Kastner et al. (2012: 6869), Fig. 1:
Developments in *per capita* food supply *(Upper)*, *per capita* cropland requirements for food *(Middle)*, and total cropland requirements for food *(Lower)* at global and subcontinental levels for the period from 1961 to 2007; according to 11 food categories

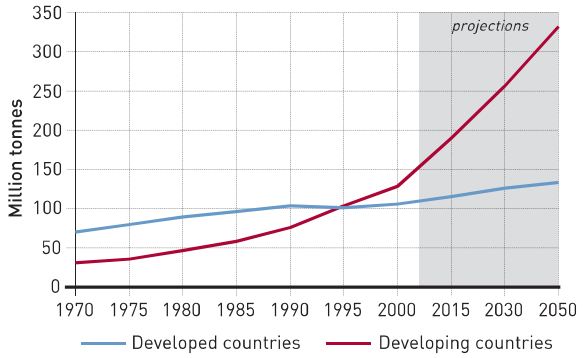

Figure 3 – Steinfeld et a. (2006: 15), Fig. 1.6:
Past and projected meat production in developed and developing countries from 1970 to 2050

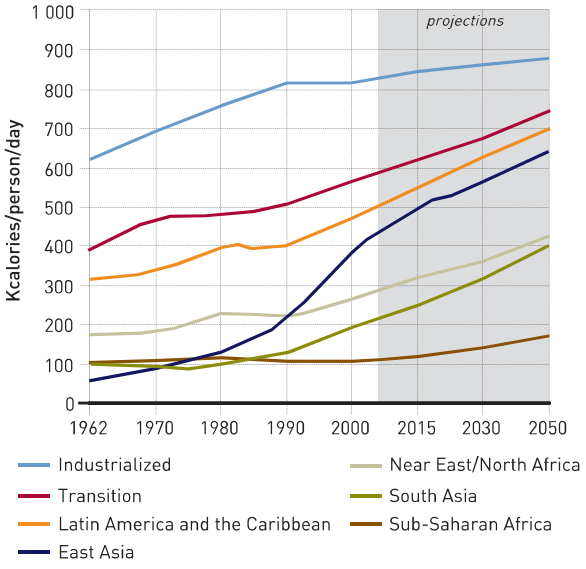

Figure 4 – Steinfeld et a. (2006: 10), Fig. 1.5:
Past and projected food consumption of livestock products

Note of the authors: For past, three-year averages centered on the indicated year. Livestock products include meats, eggs, milk and dairy products (excluding butter). — These trends, Mc Michael et a. (2007) note (153: 5), 'assume no policy-induced change from present consumption.' — *See also: UNEP (2012), Fig. 1 (199: 1) (global evolution); McMichael et a. 2007, Table 1 (153: 6) (current regional consumption levels).*

Table 1. Additive decomposition according to contributions of changes in population, diet, and technology to overall changes in cropland requirements for food

Region	Cropland requirements for food in 2005	1963–2005				1963–1984				1984–2005			
		Δp	Δd	Δt	Δtot	Δp	Δd	Δt	Δtot	Δp	Δd	Δt	Δtot
World	1,105	682	239	−654	267	345	112	−391	66	314	123	−236	201
Eastern Asia	219	97	130	−139	88	53	52	−96	9	37	75	−33	79
Southern Asia	240	188	36	−164	60	97	14	−74	37	95	23	−96	23
Western Africa	63	46	11	−19	37	16	−2	−6	8	26	23	−20	29
Southeastern Asia	70	44	23	−37	30	23	10	−20	13	21	13	−17	17
Eastern Africa	53	45	−1	−19	25	18	−1	−12	6	24	−0	−4	19
South America	67	45	14	−34	25	25	4	−12	16	22	12	−25	9
Northern Africa	42	28	12	−15	25	14	8	−6	15	16	4	−10	9
Central America	26	19	7	−15	11	10	5	−9	6	9	2	−5	5
Western Asia	31	25	4	−19	11	13	4	−11	5	12	0	−7	6
Middle Africa	17	14	−1	−4	9	5	−1	−2	3	9	−1	−2	6
Southern Europe	39	7	13	−15	6	5	9	−9	6	2	4	−7	−0
Northern America	78	34	13	−42	5	15	4	−24	−4	17	8	−17	9
Oceania	8	4	−0	−3	1	2	−0	−1	1	2	−0	−1	1
Southern Africa	9	8	1	−7	1	5	0	−3	2	4	1	−5	−1
Western Europe	39	7	6	−16	−3	4	7	−12	−1	3	−1	−5	−2
Northern Europe	18	3	1	−9	−5	1	−1	−8	−7	1	1	−1	2
Eastern Europe	94	22	5	−81	−54	24	13	−70	−32	0	−6	−16	−22

Overall changes in cropland requirements for food (Δtot), according to the contributions of changes in population (Δp), diet (Δd), and technology (Δt). Values derived based on data presented in Fig. 1 using the LMDI decomposition method; following the totals of cropland requirements for food in 2005, the results are presented for three time periods: 1963–2005, 1963–1984, and 1984–2005. All values are presented in Mha of cropland area harvested per year.

Figure 5 – Kastner et a. (2012: 6870), Tab. 1:
Additive decomposition according to contributions of changes in population, diet, and technology to overall changes in cropland requirements for food

2 Carbon footprint and food: what do we know?

NUANCED, CAUTIOUS, MULTI-VARIABLES APPROACHES ARE PARAMOUNT; BUT GHGS REDUCTION MUST COME AS A PRIORITY Before going any further in presenting trends, calculations and ways of addressing the GHGs impact of food chains, it is paramount to bear in mind, as Röös, Sundberg, Tidåker, Strida and Hansson (178, 2013) remind, that 'it is unclear how the biodiversity impact category correlates to CF. More intensive production can allow more land to be left in its natural state, but can involve increased use of pesticides and fertilisers and monocropping locally, threatening biodiversity. Using CF as an indicator of the environmental impact [...] can generate conflicts with other environmental categories in some cases. However, the risk of damaging other environmental areas when acting on CF must be weighed against the risk of further neglecting to act on global warming by failing to exploit the current market momentum of carbon footprinting' (178: 573). In the optimistic scenario that diets should adapt to ideal carbon-optima, growth in population will still entail increase in productivity or land use, and additional trade-offs must be considered.

In the case of diets, Tukker et a.'s case study of three diets has established that for the same impact on climate change, different diets had profoundly different impacts on other variables, [18] and most models do not provide an overall estimate (assuming such estimates could be provided at all, beyond case studies!): thus Tukker et a. regret confess their model does not provide any numbers on biotic depletion (198: 1783).

As Licker et a. (2010) write in their work in estimating climatic 'yield gaps', 'with conventional practices, bringing crop yields up to their climatic potential would probably require more chemical, nutrient and water inputs. These intensive land management practices can adversely affect ecosystem goods and services, and in turn human welfare. Until society develops more sustainable high-yielding cropping practices, the trade-offs between increased crop productivity and social and ecological factors need to be made explicit when future food scenarios are formulated' (398: 1).

The key idea here is, as Goodland writes, that working in priority with low food chains—which means, with CF—'would buy valuable time to implement other prudential measures on the transition to a sustainable society and would postpone the onset of worse environmental damage' (120: 196).

2.1 The importance of food

Food is rarely thought of in common discussions when discussing carbon emissions: its importance is very underestimated, when not simply overlooked.

DIET AND ENVIRONMENTAL IMPACT: A RELATIVELY NEWLY STUDIED RELATIONSHIP Whilst political aspects of food have long been a preoccupation—almost an 'obsession', Watson and Caldwell write, at least amongst educated elites denouncing, since the early 1990s, the new 'McGoulag Archipelago'[19] and the 'McDonaldization of Society'[54]—, studies of how our dietary choices affect the *natural* environment, on the other hand, are relatively recent: the notion of sustainable food consumption emerged in the 1980s, but 'with the overriding goal of feeding a hungry world, little attention was paid to the sustainability of afro-ecological zones, [and] the sustainable diet's concept was neglected for many years'.[350] If the problem had already been well formulated back in 1971 with Frances Moore Lappé's *Diet for a small planet*, the question never got attention from academics and policy-makers. As M. Berners-

18. Compare for instance Fig. 2 and Tables 7 & 8 (198: 1783 & 1784).

Lee (239, 2012) notes, not before 1997 and Robert Goodland's analysis did academic works point out again that 'diet matters,' at a time when 'there [was] no agreement that diet matters for environmental sustainability in the agriculture sector.'[120] Since then, studies began to investigate more systematically the relationship between embodied GHGs emissions and diet.[88,170] 'Since then, using life cycle analysis and input-output models, it has been shown that consumption of different foodstuffs results in differing energy consumptions and GHGs emissions':[239] following Carlsson-Kanyama et a.'s studies of the relationship between diet choices and GHGs emissions in Sweden,[78–81,83] a body of work has developed, discussing the question for the Netherlands,[136] Sweden,[203] the UK,[66,94] India,[165] the EU,[198,210] the US[100,206] and globally.[186] And the same goes for policy measures, among which carbon labels: 'the field [...] is still in its infancy, and important questions that need to be answered if carbon labelling is to be more than just a fad remain' (281: 10).

Within the institutional world, the FAO's first expressed concerns about climate change impacts on agriculture did not come before 2003, with a recently revised[62] report,[76] and gained since considerable attention as well.

As for how 'ordinary people' look upon the issue, a first reason for mobilization against 'new food practices' was without a doubt primarily linked to health issues, following the mad cow fiasco of the 1990s and the avian flu in 2004,[29]—not to mention the most recent cases—which cast shadows upon new industrialized food chains methods, GMOs and others: 'Precautions that once might have been treated as symptoms of behavioural neurosis (minute examination of labels, double-washing of produce, rejecting slightly bruised fruit) are now everyday practices in millions of middle-class homes'[29]

DIETARY CHOICES AND CARBON FOOTPRINT: INDEED A BIG DEAL Although no study yet exists that estimates the entire GHGs released by all food chains at the global level,[184] and numbers are discussed, most estimations find the agricultural sector only to be responsible for about 13% of total anthropogenic GHGs emissions; [19] and many studies have been made on local, sector or national levels, gathering a variety of compelling data and information. To this 13% figure must be added the GHGs emitted due to the impacts of land use change, which will will discuss p. 27.

In his 2010 book *How Bad Are Bananas?* as in 'The relative greenhouse gas impacts of realistic dietary choices' (2012), Mike Berners-Lee intended to draw public attention to our 'unseen' carbon footprint, and especially that of our *dietary* habits, and found that a more responsible, carbon-aware modification of our alimentary habits, e.g. a vegetarian diet, '[would be] equivalent [for the UK] to a 50 % reduction in current exhaust pipe emissions from the entire UK passenger car fleet. Hence realistic choices about diet can make substantial differences to embodied [GHGs] emissions.'[239]

In their work with California, Marlow et a. have found that 'for the combined differential production of 11 food items for which consumption differs amongst vegetarians and nonvegetarians, the nonvegetarian diet required 2.9 times more water, 2.5 times more primary energy, 13 times more fertilizer, and 1.4 times more pesticides than did the vegetarian diet' (152: 1699), and M. Berners-Lee has shown that more adapted dietary behaviours could lead to 'potential GHGs savings of 22 % and 26 % [...] from the current UK-average diet to a vegetarian or vegan diet, respectively'.[239]

THE CASE OF MEAT AND DAIRY PRODUCTS It was the very topic with which Robert Goodland introduced the global food sustainability debate in 1997 (120): when considering food-related CF

19. 13.8% globally in 2005, according to the World Resources Institute[49] *(see Fig. 6)*; 10,6% in the EU–27 in 2010, according to EU statistics. A list of different potential data sources on GHGs if to be found here.

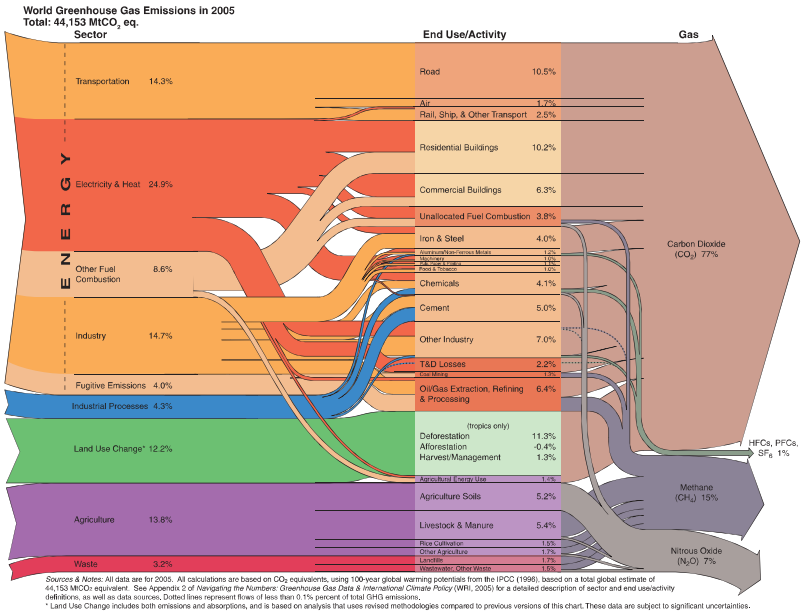

Figure 6 – Herzog (2009: 2):
Global GHGs emissions in 2005 by sector

The agricultural sector, in purple, accounts for 13.8% of the total with livestock and manure only accounting for 5.4%; that of land use change (green) for 12.2%. Both considered as a whole therefore approximately account for 26% of all GHGs. The figure doesn't take into account international air travel.

and EF, livestock—that is, all kinds of meat and dairy—comes as a priority for reduction and dietary changes,[44, 66, 67, 69, 78, 80, 83, 96, 100, 101, 116–118, 120, 124, 133, 153, 174, 198, 199, 206, 237, 239, 384] and so under any perspective; not to mention the many health issues caused by too important meat consumption, and growing ethical issues[451] adding to the policy agenda.[153]

If discrepancies exist between calculations, as Herrero et a. (128, 2011) have shown—from 8 to 51%![20]—, and while even studies such as the EU's official report on the question must confess 'considerable uncertainty' (142: 37, Conc., § 3), the most consensual, recognized international panels calculated estimates agree on a figure of 15–24 % of total GHGs emissions, as has concluded the FAO's 2006 estimate, placing meat and dairy far ahead any other foodstuffs' CF. The usually used number is a medium value of 18%.[128, 187], [21]

20. Different methodologies and probable differences between countries show very contrasting results. As Herrero et a. consider a 8–51% variations, D. Huffman (281: 26 *sq.*) also points out the differences in studies results between countries (while according to Wallén et a. [2004] meat and dairies account for a 28% share of the CF of food in Sweden, equalling Kramer et a.'s [1999] estimated figure for the Netherlands, Weber & Scott's [2008]analysis for the US concluded on a much bigger, almost twofold 58% figure) and methods (for 'the same' kilo of beef, Ogino et a. [2008] estimated the CF, in Japan, to 36 kg, while Casey and Holden [2006] had found, in Ireland, a total of 'only' 13).

21. Whilst not criticizing the FAO's results, Tukker et a. (2011) have found 'slightly less than the 18% global

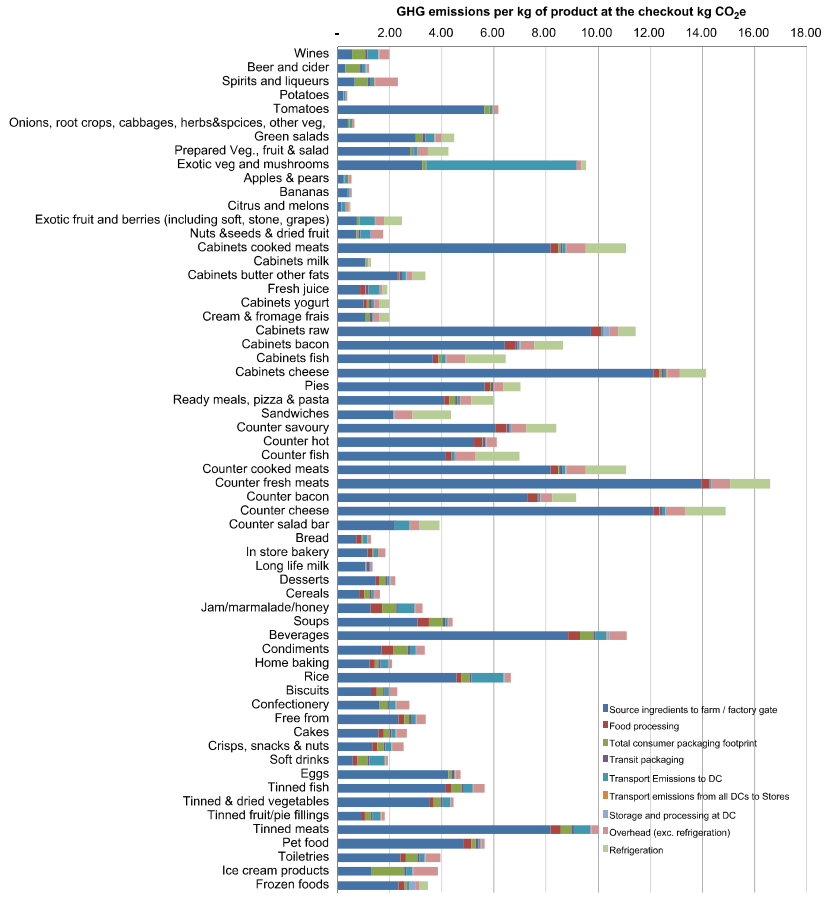

Figure 7 – Berners-Lee (2012: 186), Fig. 1:
Greenhouse gas emissions (kg $CO_2e{\cdot}kg^{-1}$) embodied in 61 food categories, at the point of purchase

See also, particularly: Carlsson-Kanyama & González (2009), Table 3 and Fig. 1 p. 1707, Table 4 p. 1798; Kramer et a. (1999), Table 1 p. 207–209, Fig. 2 p. 210, 3 p. 211, 4 p. 212, 5 p. 213 & 6 p. 214, Weber et a. (2008)…

That is a higher score in the total GHGs release scheme than that of the whole of the transportation sector, and the first individual cause of land requirements increasing.[118] Eshel and Martin (100, 2006), Gerber et a. (118, 2007) and Stehfest et a. (186, 2009), particularly, have

average contribution of meat and dairy mentioned [in 187],' but 'Europe's Global warming contribution due to fossil energy use is higher than the global average, so that it is logical to expect a lower relative contribution of meat and dairy' (198: 1782), and overall, Tukker et a. agree with the existing literature.

shown, as M. Berners-Lee, 'the disproportionately high emissions of GHGs associated with meat and dairy production, compared with plant-based foods'[239] *(see Fig. 2)*: 'the livestock sector emerges as one of the top two or three most significant contributors to the most serious environmental problems, at every scale from local to global: it is by far the single largest anthropogenic user of land', Gerber et a. write (118: 37), [22] causing GHGs pollution and biodiversity threats, and using a large share of water resources. Therefore 'The most important dietary distinctions are between meat-based and plant-based diets and the different ways foods are grown, processed, and transported.'[96] Foley et a. (2011) analyzed the potentialities of a diet shift in addressing food issues, and the UNEP showed the meat production increase tendency and praised mitigation or reduction policies.[199] *(See Fig. 3.)* These mitigations options are not only quantitatively needed, but qualitatively attractive: as González et a. (2011) have shown, 'remarkably, the efficiency of delivering plant-based protein increased as the amount of protein in the food increased, while the efficiency of delivering animal-based protein decreased' (124: 1).

Need we all be vegans? Meat and meats: learning the differences. — As Tukker et a. remind (198:1776), Weidema et a. (208, 2008) and McMichael et a. (153, 2007) have shown the existing room for all kind of technical socio-economic improvements along the production and consumption chains to withhold a 20% reduction in GHGs emissions potential only, meaning that whatever the scenario, its quantitative reduction in diets *is not optional* if one aims at sustainable food chains: 'moderate diet changes, Tukker et a. write, are not enough to reduce impacts from food consumption drastically' and attain the shifts needed in agriculture (198: 1785). [23] First off, it should be reminded, with Goodland, that 'humans do not need to eat flesh to stay healthy, according to the Nobel biochemist laureate Konrad Bloch (1994), not even infants.' (120: 197); but whereas some authors do plead for vegetarian or vegan diets,[237,239,451] McMichael et a. engage to a more plausible, meat consumption reduction scenario:

> To prevent increased greenhouse-gas emissions from this production sector, both the average worldwide consumption level of animal products and the intensity of emissions from livestock production must be reduced. An international contraction and convergence strategy offers a feasible route to such a goal. The current global average meat consumption is 100 g per person per day, with about a ten-fold variation between high-consuming and low-consuming populations. 90 g per day is proposed as a working global target, shared more evenly, with not more than 50 g per day coming from red meat from ruminants *(153: 1.)*

Within the 'reduction scenario,' it is paramount to emphasize the difference between meaty foodstuffs: should indulging in overly meaty diets remain, meat-eaters and policy makers must bear in mind that not all meats have the same environmental impact, and within the non-vegetarian diet spectrum, Baroni et a. (2006) have shown important variations. Goodland, again, already noted in a rather illustrative manner: 'Feedlot cattle consume 7 kg of grain to produce a single kg of liveweight. Pork takes nearly 4 kg of grain per kg of liveweight. Poultry and fish are more efficient converters, needing about 2 kg of grain for each kg of liveweight

22. See 133: although it is not the only land use to be debated, 'among the food categories accounting for increasing land demand, animal products are the most important ones, representing almost half the additional cropland requirements since the 1960s. Considering the vast areas of pastures and grasslands used for livestock grazing, their actual land requirements are even larger' (p. 6871), followed by vegetable oils and stimulants (tee, coffee, cocoa).

23. Goodland wrote that 'the changes needed ate gradual and relatively modest; nothing draconian,' (120: 197), but that referred rather to the human effort he foresaw than it did to the shifts in food chains needed to accompany it, thus one should not read both contributions as contradictory.

produced' (120: 194–195) [24].

To which production methods can be added: should policies be enforced to diminish meat consumption, calculation methods, as McMichael et a. point out, '[need] refinement to be more inclusive, and to deal with differing emissions intensity between different livestock production methods' (153: 10). Cattle grazing and game ranching, organic and non-organic methods have thus been opposed in terms of land use, energy requirements and GHGs emissions:

> Whether conventional and organic systems of animal husbandry differ materially in terms of energy use and emissions of greenhouse gas per unit production is contentious; studies have produced inconsistent results. A [...] UK analysis [from DEFRA] concludes that, although organic production uses less total energy per kilogram of meat output than conventional production, it emits more [GHGs]. Feeding animals higher-quality digestible feed-grain concentrates reduces methane emissions from enteric fermentation (and achieves more efficient of conversion of actual food energy). [187] shows that, in absolute terms, the total [GHGs] emissions from intensive (feed-grain based) production methods—especially methane—are much less than from extensive (pasture-based) methods. That difference, however, also reflects the predominant reliance on extensive methods, worldwide. *(153: 7. See also e.g. 191: box 5, p. 20.)*

This joins again P. C. West et a. (2010), to whom 'carbon stocks are predicted to increase in a small fraction of the area in our analysis (<0.09%). Areas with increases were most common in sparsely vegetated grasslands and deserts, which may now be irrigated. Variation within each of the climate regions is driven by different distributions of ecosystem types, climate, and soils.'

2.2 Measuring impacts: from theory to practice

THE IMPORTANCE OF LAND USE. IMPLICATIONS ON TRADE AND CROSS-BORDER COOPERATION POLICIES If emissions from agriculture represent a 13% figure, together with land use, they rise to a 35%, representing 9% of global CO_2 emissions, 35–40% of methane and 65% of nitrous oxide. REF.

Three issues are to be considered with respects to land use and food chains, both of which can be addressed simultaneously within food chains:

1. the 'looming land scarcity'[138] and the risk of land shortage to provided food to a growing population. Livestock would use up to 70% of current agricultural land and 30% of total land (187: xxi) (issue also raising the question of the use of land for biofuels, which is beyond the scope of our study): thus countries' race for livestock food increases: China, a net exporters of soybean until 1993, now more and more relies on Brazilian soybean to feed its livestock (153: 7—see e.g. the noteworthy Table 2.8 in 187, p. 44), a change which needless to say with the consumption prospects ahead, considerably increases the pressure on land;
2. closely related to the first, the unclear consequences of additional land shortage due to climate change effects within short, medium and long terms. As McMichael et a. write, 'assessments of the effects of climate change (entailing changes in temperature, rainfall, humidity, and extreme weather events) on the quantity and security of food

24. It should be noted that Goodland's estimations given later for dairy products do not seem to be up to date. Other more accurate estimates are signaled throughout this study and in the references.

supplies requires complex modelling, spatially differentiated across Earth's productive land surface. In the 1990s, first-order models forecast that climate change would result in agricultural winners and losers, in rough balance, but with developing countries being more vulnerable. [25] Later versions of these studies indicate that this inequality will probably worsen. The IPCC's Fourth Assessment Report concludes that, by 2020, crop yields could increase by 20% in east and southeast Asia, but decrease by up to 30% in central and south Asia, and that rain-fed agricultural output could drop by 50% in some African countries' (153: 5). Fischer et a.'s 2005 study concluded that in all but one scenario, hunger would be halved, whilst inequalities in access to arable land increase, but other recent research shown less optimism (see e.g. 146 and 153's review, p. 6);

3. with respect to GHGs emissions, in most estimations of food chains contribution to climate change and mitigation options, a common pattern is that 'the first major uncertainty is ignoring land use impacts [...] While deforestation is linked to global food markets, tracing its impacts directly to consumer demand for food is a difficult task, especially given the recent confluence of biofuel and food markets; nevertheless, it should be noted that the actual climate impacts of food production are much larger than just emissions of CO_2, CH_4, and N_2O', Weber and Matthews write (206: 2512).

While land-use scenarios must be careful with 'what-if scenarios', as Herrero et a. rightly pointed out (128: 780) and other overly hypothetical approaches, the many questions of land use and its potential shifts oughtn't be disregarded altogether.

The 'formula' for agricultural sustainability—generally formulated, as Goodland does, as 'maintaining the two source and sink environmental services unimpaired' (120: 190)—is well formulated from a land-use point of view by P. C. West et a. (452, 2010) as follows:

> Natural ecosystems are likely to be maintained when crop production needs are met elsewhere and on lands where *(i)* crop yields are marginal, *(ii)* the value of carbon outweighs the value of crops, and/or *(iii)* natural ecosystems provide multiple high-valued services such as water purification, recreation, or biodiversity conservation. *(452: 19646–19646.)*

To Foley et a. (2011), a better agricultural use of land could 'double food production while greatly reducing the environmental impacts of agriculture'. How so?

To come back to meat, which Foley et a. present as 'especially' responsible for the existing and future pressures on agricultural systems, Stehfest et a. (2009) have shown that not only can meat consumption reduction adress health and CO_2e issues, but would have

> a dramatic effect on land use. Up to 2,700 Mha of pasture and 100 Mha of cropland could be abandoned, resulting in a large carbon uptake from regrowing vegetation [...] Dietary changes could therefore not only create substantial benefits for human health and global land use, but can also play an important role in future climate change mitigation policies.[186]

Such an issue of course also tackles a wide range of linked issues, but most especially that of deforestation in developing countries *(see below, p. 58)*.

Other studies however question the role or impact of land use shifts, reaching, for developed countries, conclusions opposing those of Steinfeld, Gerber et a.'s often quoted UN report, *Livestock's Long Shadow* (187, 2006). Pitesky, Stackhouse and Mitloehner (168, 2009) have thus estimated that for the US, meat was only responsible for a tiny 3 % of GHGs emissions, precisely because there was no significant, or too little carbon release nor uptake from land use shift. These assumptions were discussed before (p. 23): let us just point out that for the US' 'special case,' the debate must take into account that if the land US *shift* due to meat production in

25. See e.g. 71, 163, 164 and 180.

the US would be low, it may also well be because the US' land use *already* stands amongst the worst.

We shall rather follow Herrero et a. in supporting the report. Stating that meat production has little effect on land use and GHGs emissions is wrong and dangerous on two levels: ———

It is nevertheless true that the impact of land use shift isn't the same in the tropics and in temperate zone, and policy makers must bear in mind that the agricultural/carbon trade-off isn't the same everywhere. 'The difference amongst regions is striking', write P. C. West et a. (2010), who have taken local, national and regional studies to apply them worldwide: 'Trade policies may simply shift land uses from one country to another, and therefore, global analysis is required to determine the net effect of local land use decisions and assess implications for greenhouse gas concentrations and climate':[452]

> for each unit of land cleared, the tropics lose nearly two times as much carbon (~120 tons·ha^{-1} vs. ~63 tons·ha^{-1}) and produce less than one-half the annual crop yield compared with temperate regions (1.71 tons·ha^{-1}·y^{-1} vs. 3.84 tons·ha^{-1}·y^{-1}). Therefore, newly cleared land in the tropics releases nearly 3 tons of carbon for every 1 ton of annual crop yield compared with a similar area cleared in the temperate zone.[452] *(See Fig. 8 & 9.)*

Region	Percentage of region in cropland	Average annual dry yield, all crops (tons crops·ha^{-1}·y^{-1})	Average change in carbon stock from land conversion (tons C·ha^{-1})	Average tradeoff index (tons C·ha^{-1}/tons crop yield·ha^{-1}·y^{-1})
Tropics	10.5	1.7	−120.3	−76.9
Subtropics	13.5	3.3	−68.3	−27.0
Temperate	20.4	3.8	−62.9	−26.9
Boreal	1.4	3.7	−71.5	−37.0
Polar	<1.0	2.2	−10.5	−4.7

Figure 8 – West et a. (2010: 19646), Table 1:
Summary of crop yield, carbon stocks, and tradeoffs

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Not only does deforestation account to ~12–20% of worldwide annual GHGs emissions, and agricultural lands expanded ~10 million ha·y^{-1} between 1980 and 2007, but 'cropland expansion during the 1980s and 1990s was greatest in the tropics. Over 80% of new tropical croplands in the 1990s replaced mature or degraded forests', releasing much more carbon than those previously cleared.[452] If it is likely to continue growing from now to 2050 in order to match the demand—by 50%, P. C. West et a. say, sound trade policies *must* consider this environmental trade-off, for the 'highest average carbon loss' goes (in the tropics) with 'lowest average yield values', and tropical forests currently store ~40 times annual global fossil fuel GHGs emissions.[452] Even if agriculture in the tropics doubled temperate regions agricultural productivity (through mechanisation, improved techniques), it would still emit ~35 tons of carbon per ton of annual crop yield, conclude P. C. West et a., who therefore call for reforestation. But should tropics be 'preserved' from further agriculture (currently 10.5% of it is cropland)[452] or, better, reforested, this of course asks the question of how disencouraging agriculture in these regions may be duly, fairly, and effectively controlled and compensated: 'local and global outcomes must be coupled to manage ecosystem services and assess their tradeoffs', 'to reduce future carbon emissions and meet crop demands, private and multilateral investments should focus on maintaining or restoring tropical forests and increasing yields through low petroleum inputs on existing cropland'.[452]

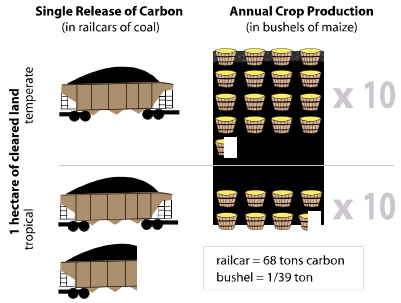


Figure 9 – West et a. (2010, p. 19648), Fig. 4:
Tradeoffs of carbon and crop production in temperate and tropical regions

'Each hectare of land cleared for cropland in the temperate region releases an average of 63 tons of carbon and annually produces an average of 3.8 tons of dry crops. In contrast, a hectare of cleared land in the tropics releases an average of 120 tons of carbon and annually produces 1.7 tons of dry crops. The tradeoff varies depending on type of ecosystem cleared, soil type, crops planted, and crop management practices. We assumed that the coal was 75% carbon, making a standard railcar of coal equivalent to 68 tons of carbon. Dry yields were adjusted to account for the 11% water content in harvested maize grain.'

Furthermore P. C. West et a. point out that data may vary locally, and that they have not taken into account other criteria of environmental footprint, e.g. the use of fertilizers (which some studies say may help 'save' more emissions than they cause) and LCA, nor considered other environmental impacts of agriculture nor other ecological services provided. [26] Either way the impacts and other tradeoffs are likely to be more or less the same in temperate zones, which leaves the global tradeoff globally unchanged.

Climate change and tomorrow's land use — Another point to be considered on short to middle and long-term bases is that of the very impact of climate change itself upon the 'agriculturalibility' of many cultivated zones. As this requires too large a prospective work for our focus, let us just refer to William Easterling, Pramod Aggarwal et a.'s contributions to the IPCC's Fourth Assessment Report.

eHANPP and GDP: beware of short conclusions! — Haberl et a. (2012) have shown that

> material and energy throughput, fossil-energy related CO_2 emissions as well as the ecological footprint are highly correlated with each other as well as with GDP, while eHANPP is neither correlated with other resource use indicators nor with GDP, despite a strong correlation between final biomass consumption and GDP. This can be explained by improvements in agricultural efficiency associated with GDP growth. Only about half of the variation in eHANPP can be explained by differences in national land-use systems, suggesting a considerable influence of

26. 'Soil and groundwater recharge, runoff, and nutrient regulation as well as ecosystems, species, and genome diversity of landscapes', 'Ecosystem services affected by agriculture include provisioning of food, fiber, and freshwater, regulation of climate through carbon storage as well as biophysical influence on regional air temperature and moisture, regulation of soil and groundwater recharge, runoff, and nutrient flows to freshwater, and cultural values of landscapes. [...] agriculture directly affects aspects of natural capital like heterogeneity of landscapes, which includes diversity of ecosystem types and species.'[452]

trade on eHANPP patterns[37]

In pointing out the main role of transportation and the illusions it can contribute to for representing one's CF, he joins Edwards-Jones et a. (2008)[98] in saying that food cannot be regarded as best or suitable simply because it comes from close, as well as Franks & Hadingham's analysis (2012).[113]

Might diet shifts risk our *exporting* land use? — Although land use changes are among the most optimistic expected outputs to otherwise rather pessimistic estimations such as Tukker et a.'s (198: 1785, quoting Stehfest et a.'s 2009 research [186]), the same authors point out that 'calculations show that in response to a changed final consumption of food products, agricultural production switches to increased exports and reduced imports of red meat products': 'rising exports of red meat explain why impacts in Europe diminish not that fast since production is not reduced according to reduction in domestic final demand. It may be that the difference that is exported avoids production and related impacts abroad, an issue not taken into account' (198: 1783), concluding that if significant diet shifts were to occur, 'The European meat production sector will most likely respond by higher exports to compensate for losses on the domestic meat market. This hence implies that impacts in Europe will drop even less.' (198: 1785). True, it might help reducing other countries' land use, but is by no means a solution to the land use and agricultural sustainability issue.

Beyond the issue of rebound effects (to be discussed *infra*, p. 46), this also brings us onto the food miles question.

LOCAL FOOD AND FOOD MILES: WHAT, WHY, WHEN AND HOW TO SUBSTITUTE? One of the most common ideas to 'solve the food problem' altogether suggests our getting back to as much local food production, as close as possible to some sort of 'alimentary autarky': it'd save transportation emissions—known, after Paxton's 1994 report, as 'food miles'[27] and which has increased considerably over the past decades[77]—, land degradation (because of a greater variety of crops on smaller fields, and better care for the immediate environment), and be healthier, for on small and local croplands, the applied methods are likely to be more considerate of the surroundings. How so?[28]

Traiter, intégrer: 83 et a.

From a strictly environmental point of view, analyses prove this idea to be potentially wrong, at best a 'trivial solution',[113] and at best a very secondary option to mitigate GHGs emissions of food chains, compared to other forms of agricultural optimization and dietary shifts. Among others, Weber and Matthews (206, 2008) have shown that 'for the average American household, "buying local" could achieve, at maximum, around a 4–5% reduction in [GHGs] emissions due to large sources of both CO_2 and non-CO_2 emissions in the production of food' (206: 3512) and the very relative importance of food-miles in the total CF of food chains: 11% in total, 4% only from retailer to consumer—that is, at the very best, *one seventh* only of what could be attained through dietary shifts, for the same amount of nutrient intake.

A compelling CF variability among freight options. — *(See Fig. 10, p. 32.)*

The 'weight' of food-miles: what are we looking at? — Weber and Matthews' study (206, 2008) has shown that in the US, although transported over long distances (1640 km delivery and

27. It is noteworthy that the idea, often presented as a 'reaction' against food chains deemed overly globalized as a result of the expansion of international trade, is not exactly new: see e.g. 63, Conclusion, map 1.

28. Needless to say, it should be noted that many social and societal choices and issues lying in the 'local debate' should be looked upon to provide a general answer; but such considerations go beyond the scope of the GHGs issue, and therefore shan't be considered in the following pages.

TABLE 1. Energy and Greenhouse Gas Emissions Per ton-km for Different Modes of Transport[a]

	MJ/t-km	t CO_2e/t-km × 10^6	source
inland water	0.3	21	(*23*)
rail	0.3	18	(*23*)
truck	2.7	180	(*23*)
air[a]	10.0	680[a]	(*25*)
oil pipeline	0.2	16	(*23,24*)
gas pipeline	1.7	180	(*23,24*)
int. air[a]	10.0	680[a]	(*25*)
int. water container	0.2	14	(*26*)
int. water bulk	0.2	11	(*26*)
int. water tanker	0.1	7	(*26*)

[a] CO_2 emissions were used as an indicator for the radiative forcing effects of aviation, which are actually higher than just CO_2 emissions (*27*).

Figure 10 – Weber & Matthews (2008: 3509), Table 1: Synthesis of freight options and corresponding CF data

6760 life-cycle supply chain, on average [206: 3508], of which 3000 'only', so to speak, that is one fourth, are the facility-retail store part [206: 3510]), it is the production phase which still contributes to a large 83% of the total of the yearly 8.1 t CO_2e food consumption CF of American households (that is without taking into account the downstream, consumer to retailer food-miles: see developments below, p. 34). Therefore although, of course, to equal carbonic production costs, food-miles may not always be an irrelevant criteria, it is more often the contrary; when looking at the carbon uptake/release ratio of the *entire* food chain including land use: see corresponding section p. 27—, the trade-off between distant land-use with longer food chains can very well be best over the equivalent short-distance option, and an informed consumer should then *not* consider food-miles a relevant criteria.

The 'trivial solution' of local foodstuffs. — Edwards-Jones et a. (98, 2008), as well as Franks & Hadingham (113, 2012) and Stefan Åström et a. (65, 2013)—among others—have shown that far from addressing the *global* issue which is sustainable consumption, the 'local is best' food idea is not always rational and may well be at best a 'trivial solution',[113] or more likely just another way to veil actual ways of addressing the food issue. As Berners-Lee has shown, bananas for instance, may come from far, they aren't at all bad from a carbon point of view, *energetically speaking*,[237] and that is as opposed to other locally-sourced foodstuffs and their relative sustenance *(see Fig. 7)*. Additionally, if the food issue ought to be looked upon from a 'social', price-based point of view, G. Brown said very clearly for the UK that it 'cannot deal with higher food prices in the UK in isolation from higher prices around the world—attempting to pursue national food security in isolation from the global context is unlikely to be practicable, sustainable or financially rational.' [29]

As we will see below,

> It is clear that even with the unrealistic assumption of zero food-miles, only relatively small shifts in the average household diet could achieve [GHGs] reductions

29. 351, p. i.

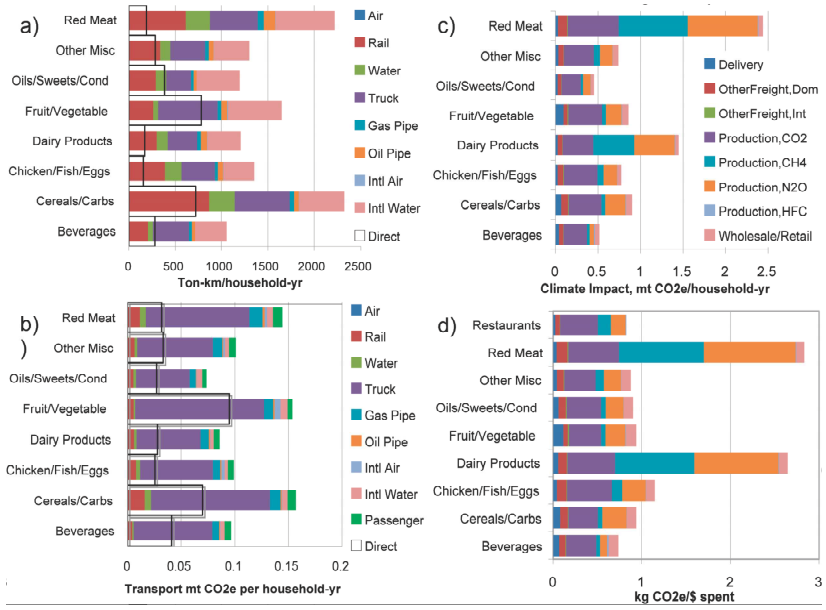


Figure 11 – Weber & Matthews (2008: 3510), Fig. 1:
Relative importance of food-miles per category

'Total t-km of freight by mode per year per household (a), transport-related GHGs emissions by mode (b), total GHGs emissions by supply chain tier (c) associated with household food consumption in the United States, and comparative climate impacts of different food groups (d). The clear boxes (direct in panes a and b) represent final delivery portion of transport chain. Food groups are aggregates of 50 commodities [see Supporting Information in the article]'

> similar to that of localization. For instance, only 21–24% reduction in red meat consumption, shifted to chicken, fish, or an average vegetarian diet lacking dairy, would achieve the same reduction as total localization. Large reductions are more difficult in shifting away from only dairy products (at least on a calorie basis) but making some shifts in both red meat and dairy, on the order of 13–15% of expenditure or 11–19% of calories, would achieve the same [GHGs] reduction as total localization.' *(206: 3512.)*

A way to reconnect? — Leaving aside the 'technical debate', the point of many in favour of 'local-based' food chains isn't that of reaching the best possible optimization scheme, so much as that of 'reconnecting' people to their food and counteract 'the aspatialities which are, or were, an intrinsic part of a globalised food order', reinstating the idea that the 'heterogeneity of edaphic conditions gives rise to varied natures represented in varied foods' (89: 150), which is a first and mandatory step towards better dietary conscience and land use, *thus* and thus only reaching behavioural shift needed towards carbon-lighter food chains. [30] All in all, it claims

30. 'What is the (added) value of local food and alternative food movements at large?', blog *Easy to digest,*

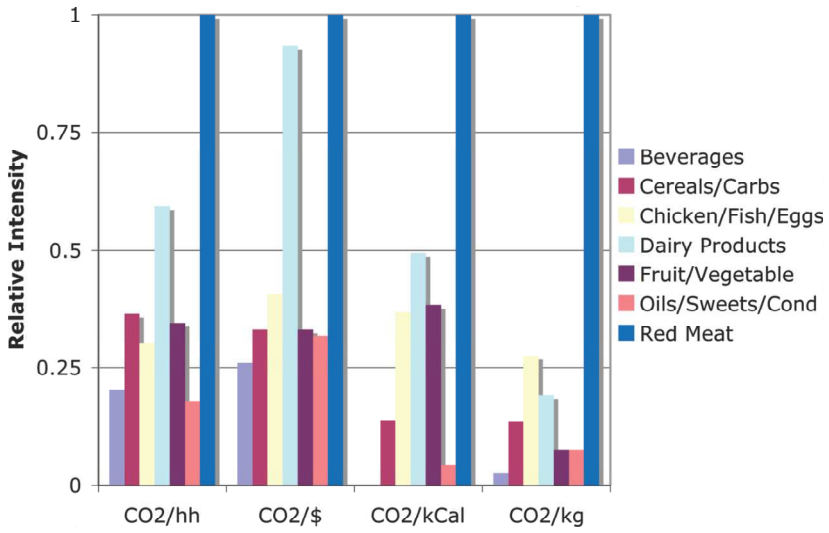


Figure 12 – Weber & Matthews (2008: 3510), Fig. 2:
Relative importance of food-miles per category

'Comparison of normalization factors for total GHGs of food. From left to right: no normalization (t CO_2e/hh-yr), by expenditure (g CO_2e/$1997), by energy content (g CO_2e/kCal) and by mass (kg CO_2e/kg). All values are shown relative to the value of red meat (2500 kg CO_2e/yr, 2.4 kg CO_2e/$, 10.8 g CO_2e/kCal, 22.1 kg CO_2e/kg).'

a different order in the steps to take towards sustainability, focusing beforehand on social and perception of the food chains issues. But to not be totally without grounds, [31] this view remains somewhat limited; and if the 'conscience shift' is the first goal to attain, Fair traded food initiatives have shown that there were other ways to go.[309]

Upstream and downstream food-miles within life-cycle analyses. Looking at the *real* big picture. — Additionally, as Coley, Howard and Winter (89, 2009) have shown, an 'overly' decentralized food chain may lead to increasing 'downstream' food-miles with personal transport over to the local retailer—a figure Weber & Matthews left aside—resulting, whatever the 'connection', in an overall *greater* release of GHGs. The producer to retail food-miles, in Weber & Matthews' study, only account for 4% of the total CF: 'local options' can *only* be deemed legitimate, as far as the CF issue goes, if the local chains allow, *overall*, to account for less than this figure. There again, they said, diet shifts are much more relevant than the geographical origin of products (206: 3508), and so are of course the agricultural practices and land uses involved in the process.

Classic approaches to the problem, Coley et a. say, such as those of AEA and Defra in the UK (see e.g. 205), have over-emphasized the upstream part of the food chain process, bounding

January 24th, 2013.

31. See for instance, for France, Association Santé Environnement France (2013), 'L'assiette des enfants : l'enquête des médecins de l'ASEF': ⟨LINK TO ONLINE PDF⟩.

to 'a balancing out of the energy used in production [...] against the extra energy used in the transport to Britain. Such a simplistic approach masks the very real differences between contrasting production and distribution systems' (89: 151).

Th result associated with final delivery (last line: 39% of final food-miles related emitted GHGs) 'lends some credence to the focus on food-miles, although it would also say that upstream transportation requirements are still more important than final delivery of food. Regardless, the focus on food-miles and transport must be analyzed in terms of the overall climate impact of food:' considering that

> total GHGs emissions are 8.1 t CO_2e/household/yr, [...] delivery accounts for only 4% of total GHGs emissions, and transportation as a whole accounts for 11%. Wholesaling and retailing of food account for another 5%, with production of food accounting for the vast majority (83%) of total emissions. Within food production, which totaled 6.8 t CO_2e/ household/yr, 3.0 t CO_2e (44%) were due to CO_2 emissions, with 1.6 t (23%) due to methane, 2.1 t (32%) due to nitrous oxide, and 0.1 t (1%) due to HFCs and other industrial gases. Thus, a majority of food's climate impact is due to non-CO_2 greenhouse gases. Nitrous oxide (N_2O) emissions, mainly due to nitrogen fertilizer application, other soil management techniques, and manure management, are prevalent in all food groups but especially in animal-based groups due to the inefficient transformation of plant energy into animal based energy. Methane (CH_4) emissions are mainly due to enteric fermentation in ruminant animals (cattle, sheep, goats) and manure management, and are thus concentrated in the red meat and dairy categories. Different life-cycle stages have different importance among the different food groups. Delivery "food-miles" account for a low of 1% of red meat's GHGs emissions to a high of 11% for fruits/vegetables, due to the higher overall emissions intensity of red meat and the lower intensity of fruits/vegetables. Total supply chain freight transportation similarly ranged from 6% of red meat and dairy's impacts to 18% of impacts of both fruits/vegetables and nonalcoholic beverages. [...] comparing among the different types of food is more relevant for consumers wishing to lower the climate impact of their food consumption. *(206: 3511.)*

Room for seasonal products, to the right amount.

There is of course room for local, season-goods produced with low CF and fewer up- and downstream food-miles, the same way that out-of-season goods purchased within a 'low carbon-intensive diet' will cause the share of food-miles in the global CF increase considerably, which would make no sense. Reijnders and Soret (2003) have even found that under some circumstances, 'although on average vegetarian diets may well have an environmental advantage, exceptions may also occur. Long-distance air transport, deep-freezing, and some horticultural practices may lead to environmental burdens for vegetarian foods exceeding those for locally produced organic meat' (174: 664S). The same way, 'several authors have noted the importance of seasonal variations and increased storage necessary for localization of produce, which are all only treated in an averaged sense' in Weber & Matthews' study, the authors write, but 'it should be noted that most of these major uncertainties (land use, increased storage) would make the benefits of localization look even more dubious compared to dietary shift' (206: 3512).

It is therefore important to always bear in mind a multitude of factors when considering food choices, which vary over seasons and places. But never can the local option claim to be better in absolute terms, nor, by any means, can it claim to be the best option if it seeks to be the only provider for an entire food chain. Its very relative importance compared to diet shifts must therefore be emphasized.

Ways of addressing the downstream food-miles. — As we have seen, the food-miles issue is

Dietary shifts and a reduction of downstream food-miles may be addressed together.

far less important than diet shifts are on the path to sustainable food chains. Yet, however secondary it may be, ways exist to reduce it that ought not to be disregarded: 'though [Weber and Matthews'] analysis shows that some food types are much less [GHGs] intensive than others, any attempt to change consumer behavior based on only one dimension of food choice is unlikely to be effective.' (206: 3513.) Besides, should both criteria need to be considered at once and with an equal priority—if, for instance, more social and political, unquantifiable, criteria towards delocalization were to come into the picture—the overall 'ranking' of foodstuffs remains unchanged, and both fights may very well be fought within one single, well-thought adaptation framework.

Comparing centralized delivery systems and personal on-farm grocery shopping.

Of all reviews and similar studies, 'all reported that overall traffic levels would fall if home delivery became common' (89: 152), but numbers differed and too many factors were ignored or changing for each case. Comparing 'the relative emissions from a system based on large-scale growing, bulk cold storage, mass distribution to regional hubs, then home delivery, with the much simpler case of a hypothetical small local farm shop', their comparative model found that on average for the UK, 'if a customer drives a round-trip distance of more than 6.7 km [6.5 for petrol, 7.4 for diesel] in order to purchase their organic vegetables, their carbon emissions are likely to be greater than the emissions from the system of cold storage, packing, transport to a regional hub and final transport to customer's doorstep used by large-scale vegetable box suppliers' (89: 150, 153), and the method indicates this is likely to be overestimated (152). They conclude that this 'surprising result [...] arises from the inherent efficiencies of the mass distribution system outweighing other emissions': 'The sum of associated CO_2 emissions for the large scale delivery system is 1394 g per delivery' (89: 153).

> Whilst it is obvious that the box system results in many more food km (on average 360 km per box in this study) than purchasing from a local farm shop, this is shared between a large number of boxes. The need to consider this point when making use of the concept of food miles was one of the main conclusions of the AEA report [in 2005] [...] the concept of food miles, as typically used, is of little value *per se* and that it is the carbon emission *per unit of produce* over the transport chain that really matters. The concept of food miles has undoubtedly served an important ideological and political role in highlighting the importance of carbon footprints in the food system. To that extent it has been a useful device in the wider sustainability debate. But it is now time for businesses and consumers to adopt a more broadly conceptualised carbon accounting life cycle assessment. *(89: 154.)*

Conclusion: the need for a much more nuanced approach on the food-miles issue. — 'The food consumer is not confronted simply with a choice between "local-good" and "global-bad"', Coley et a. go on saying, referring to Roberta Sonnino and Terry Marsden's work (185, 2006), showing that 'the claims for the heuristic value of the concepts of food miles and of local food systems need to be seen in the context of careful evidence-based case studies', and if 'we cannot expect consumers to take into account life cycle analysis of every product they buy, nor indeed that public or private sector bodies can afford to conduct such exercises for every product or retailing systems[,] what is needed is a sophisticated public debate on food systems in which catch phrases, such as "food miles", which were useful to initially capture media attention, now give way to more nuanced approaches based on strategic case studies of specific retail systems and/or key commodity sectors' (89: 154).

3 From dietary behaviours to behavioural diets: raising ecological footprint aware consumers

SUSTAINABLE DIETS: WHAT ROLE FOR SOCIAL SCIENCES? 'Harnessing' works of the UK research councils' Rural Economy and Land Use Programme (RELU) [32], J. Phillipson & P. Lowe (2008) put on show that 'the salient challenges facing food chains cut across disciplinary boundaries and that interdisciplinary research, involving the social and natural sciences, is required as a basis for sustainable development.'
[242, 295, 303, 455]

3.1 Social perceptions of food sustainability Going beyond 'Organic is beautiful'

THE NEW GREEN ECONOMY: FACTSHEET — — —

> In 2007, the U.S. Patent and Trademark Office saw more than 300,000 applications for green-related brand names, logos, and taglines. [33] The number of new products labelled with the word(s) 'sustainable', 'sustainability', 'environmentally friendly', or 'eco-friendly' increased from 100 in 2004 to 526 in 2008, with an additional 450 product launches in the first four months of 2009. Representing a 39 % increase from the previous year, 6902 products on U.S. shelves in 2010 had some type of environmental claim, including 89 claiming to be carbon neutral. [34] [...] A significant and growing proportion of the sustainability-related product claims are now focusing on carbon emissions and climate change. [...] carbon labelling of products is gaining considerable interest. Pilot programs are being implemented in the United Kingdom, Switzerland, Japan, and other countries, and there are proposals to expand and standardize such programs globally. [35]
> (253: 53)

FOOTPRINT AND TOEPRINTS: FROM CONFUSION TO 'GUESSTIMATES' A major problem, when it comes to estimating one's carbon 'footprint,' is that most of what we see and hear about are actually just estimated *toeprints*, M. Berners-Lee says (239: 6): they only take into account a small part of our full carbon impact, which is not primarily that of our everyday consumption of energy but rather that induced by our lifestyles, due to a confusion between direct and indirect GHGs emissions:

> [if] some sources of GHGs (e.g., the use of fossil fuels for residential lighting and heating) are relatively easy to monitor and reduce, at least temporarily (e.g., by increasing building insulation, improving boiler efficiency, installation of low-energy lighting systems etc.), others, especially agriculture, are much less tractable' *(2012: 184.)*

32. ⟨http://www.relu.ac.uk/⟩: '500 researchers from across 40 natural and social science disciplines [...] 29 research projects [...] interdisciplinary, involving social and natural scientists'.
33. OTTMAN Jacquelyn A. (2011), *The New Rules of Green Marketing*, San Francisco, Barrett-Koehler, quoted in the article.
34. Mintel Group (2011). *Green Marketing—U.S.—April 2011*, quoted in the article.
35. —

Taking for granted an undemanding of the importance of diet on the part of the buyers, 'Comparing among food groups is a nontrivial matter. Different food groups have different prices, provide people with different nutrients, and of course are more or less pleasant to eat depending on consumers' tastes', Weber and Matthew write (206: 3511), and of all the possible sets of criteria, 'none are a perfect measure'. Dairy products' CF, for instance, equals that of red meat per $ spent, but that figure is halved if one considers their respective calorific contribution (206: 3511).

Anyways, if no dashboard for food benefits and costs is to be made an absolute reference of, patterns do exist which 'transcend' the relative importance of each criteria: thus 'no matter how it is measured, on average red meat is more GHGs-intensive than all other forms of food'.[206]

3.2 Carbon labelling of food: methodological & trade challenges

'A carbon-labelling programme could reduce carbon emissions in two ways: by influencing consumer choices and by encouraging firms to identify efficiencies throughout the supply chain' (447: 5), and as we have seen, brands are sensitive to 'bad carbon press' even when their clientele does not show great carbon concern or willingness to change.

Besides, as Gadema and Oglethorpe showed, 'whilst there is general confusion and misunderstanding around carbon labelling, this is not driven by an unwillingness to learn or an apathetic position. In the main, consumers do want to be able to make choices around the carbon credentials of products (72%) but do not feel empowered to do so' (269: 820).

METHODOLOGICAL ISSUES

Calculation and information. — 'Ideally the label would consider the climate effects arising from the full product life-cycle: production, transportation, use and disposal. The challenges of life-cycle assessment are substantial, but this is an active area of research. The value of the label comes not from providing perfect information, but better information than the consumer has at present' (447: 6).

Many initiatives have already been taken in the field, as reviewed by Vandenbergh et a., and the big issue really bounds to pull the pieces together and go global, under a unifying and trustworthy scheme:

> The International Standardization Organization is developing ISO 14067, a carbon-labelling standard for products, with a target completion date of 2011 [belated: see p. 56]. The British Standards Institution (BSI) is facilitating the development of Publicly Available Specification (PAS) 2050, a private standard designed to identify the requirements for life-cycle assessment of GHGs emissions of goods and services [...] . The Carbon Disclosure Project has focused on firm-specific, not product-specific emissions, but it has induced over 1,000 of the largest global firms to voluntarily disclose Scope 1 (direct) and 2 (energy-supply-related) carbon emissions using a common protocol, and it is encouraging firms to disclose Scope 3 (for example, supply chain and other) emissions using an accounting tool known as the Greenhouse Gas Protocol. Several non-governmental carbon labels are used by single companies or targeted at a larger market, but none have a global reach at this point. *(447: 6.)*

In order to reach the desired effect on the consumer's 'product analysis', labels must both easily recognizable and easily interpretable, and have credibility.[424] In order to indeed influence their choices (influencing not only the product analysis, but that of the market), they must also reach all products of a given category as to provide sufficient comparative data.

> Inconsistencies in the methodologies and results calculated are strongly prevalent even amongst the most technically experienced professionals in the field, raising scepticism of the methodologies being adopted. At the local level there is unanimous concern amongst the respondents about the incorporation of the ecological footprint approach as a main driver into an already very broad set of policy initiatives. One of the reasons being that many of the issues covered by the ecological footprint are felt to be of a scale beyond the control of the local authority. One issue highlighted by many ecological footprint studies is the lack of available data concerning the consumption *(235: 9.)*

Barrett et a. (2004) identify five key points to a successful EF approach (235: 10):

1. Commitment by the organisation across all areas and not just one individual;
2. Adopt the ecological footprint for monitoring meaning that it will be re-calculated on a regular basis;
3. Integrate the ecological footprint into a meaningful strategy that is seen as one a guiding force within the organisation;
4. Don't 'over-sell' the ecological footprint always identifying limitations;
5. Transparency and accountability are essential for both the data sources and calculations.

(Point nº 5 could be achieved though granting oversight and control power over labels to exterior institutions such as NGOs.)

CONSUMER MARKETING AND CONSUMER PEDAGOGY. FROM INFORMATION TO STORY-TELLING In classical economy analysis, an information isn't taken into account if its cost exceeds its benefit—and that is all the more true when the benefit isn't 'yours' or felt by you, but spread out through a supply chain and the whole planet, and felt within long periods of time as it is with GHGsṪhey is why step one needs to be that of pedagogy: 'in order to demand information, consumers need to know the value of it'.[253]

Studying how discourse influenced buyers choices towards more sustainable consumption in Sweden, Karl Johan Bonnedahl and Jessica Eriksson[242] — — —

It is common knowledge that identities cannot be attacked or questioned though merely rational arguments, and food is of course part of our identities. Therefore beyond labelling and pricing policies, an understanding approach of the problem must consider a discursive approach.

Consumers, whatever well-meaning, tend to fall prey to the first appearing or most convincing *marketing* information, which as any advertising remains is a trade-off between seducing/selling and providing appropriate information to get a better share of future purchases. If some brands do live only off the 'green market' and with an authentically ethical approach to their market, they are nonetheless all the same part of the economy, and provide goods and services to clients who we saw do not respond to the *actual* best 'ecologically rational' arguments but to more subjective, directly 'felt' ones *(see Fig. 14)*.

'COMPASSION WITHOUT ACTION': INFORMATION IS NOT ENOUGH. CONSUMER ATTITUDE AND CONSUMER BEHAVIOUR: WHAT PRIORITIES ARISE? 'It is just a start. We can set the right framework, but we will need everyone—from the consumers who use their buying power to shape new markets, to the producers right along the food chain who supply the food we want to buy—to play their part and to work together if we are to make our food safer, healthier and more environmentally sustainable in the years to come', G. Brown writes. [36] Whilst much

36. 351, p. i.

remains to be done to reach the 'first step' of proper FEFP information, Margee Hume (2010) has shown that information *is not enough, even* to those empathetic of the 'ecological cause', to reach satisfactory levels of involvement and behavioural adaptation, including the young, who stand among the most likely to adapt. [37]

Bonnedahl and Eriksson (2011), though studying the country where ecological motives in consumption are among the very highest (Sweden [38]), have also shown that discourse reached limits when facing 'classical' economic analysis, whilst concluding, and this is important, that it could, on the other hand, favour acceptance of stricter regulations to make up for the limits of market mechanisms.

In France, although 77 % of the population claim to be willing to adopt more environmental-friendly products, only 19 % actually do. [39] The proportions of bought eco-labelled products is rising, but its share of the global market remains small, and their purchase still mainly responds to health and budgetary motivations.[424] The previous widely known and most important labelling policy was that of home appliance, created in 1994 and mandatory as of 1995. [40] But whilst it reached a true, wide impact, [41] it can be argued that the change in home appliance buying behaviour aimed primarily at reducing energy costs: it didn't have an environmental motivation as much as an economical one.

LABELS USE AND USEFULNESS 'As much as the carbon labelling of food is a matter of science and statistics, it is to an equal extent a matter of efficient communication and appealing to consumers',[281] and 'while little empirical evidence has yet been generated with respect to carbon footprint labels, much can be learned from our experience with similar product labels', claim Cohen and Vandenbergh.[253]

As shown in Gadema & Oglethorpe's study (269, 2011), 'whilst consumer demand is relatively strong for carbon labels with a stated preference rate of 72%, confusion in interpreting and understanding labels is correspondingly high at a total of 89%, primarily as a result of poor communication and market proliferation' (269: 815).

How labels work: Thogersen's model. — After J. Thogersen's 2010 article (330), the consumers' behaviour model towards ecolabels is referred to as Thogersen's model. In order to pay attention to an ecolabel, as D. Huffman (281: 4) recalls, consumers must beforehand have come to

1. form a desire to protect the environment;
2. know about eco labels, in particular how they work;
3. believe in product labelling as a suitable strategy for reaching this goal;
4. be attracted by the eco label;

37. See below, Gadema and Oglethorpe's clusters analysis.
38. See e.g. Fig. 18 and 19.
39. 424, p. 4. '47 % sont résolument engagés dans leur volonté de consommer autrement en faveur de l'environnement', '24 % sont dans une situation intermédiaire. La moitié d'entre eux demande à être convaincue de l'intérêt de la consommation durable, l'autre moitié est à la recherche d'économies budgétaires que permettent certains comportements écologiques', '29 % [but decreasing] ne sont guère enclins à changer leurs modes de consommation'.
40. European directive 92/75/CEE of the Council, September 22nd 1992: ⟨LINK TO ONLINE PDF⟩.
41. 'La mise en œuvre de l'étiquette s'est accompagnée en France d'une hausse des ventes des appareils les plus efficaces : en 2009, 90 % des machines à laver vendues appartenaient à la classe A, tandis que la totalité des ventes concernaient des appareils classés de B à G en 1996. Cette évolution peut être raisonnablement attribuée à l'étiquette : en 2011, 85 % des consommateurs la connaissaient et 63 % d'entre eux en faisaient un critère d'achat'[424]

5. trust the information that the eco label conveys. [42]

Suppliers and retailers within an eco-friendly competitive economy. — Liu, Anderson & Cruz (2010):

> as consumers' environmental awareness increases, retailers and manufacturers with superior eco-friendly operations will benefit; while the profitability of the inferior eco- friendly firm will tend to increase if the production competition level is low, and will tend to decrease if the production competition level is high. In addition, higher levels of retail competition may make manufacturers with inferior eco-friendly operations more likely to benefit from the increase of consumers' environmental awareness. Moreover, as production competition intensifies, the profits of the retailers will always increase, while the profits of the manufacturers with inferior eco-friendly operations will always decrease. The profitability of the manufacturers with superior eco-friendly operations will also tend to decrease, unless consumers' environmental awareness is high and the superior manufacturer has a significant cost advantage related to product environmental improvement *(294: 602.)*

THE LIMITS OF SOCIAL MARKETING: TO WHAT EXTENT IS THE PUBLIC 'CARBON CAPABLE'? BREAKING AWAY FROM THE 'CLEARLY UTOPIAN' SELF-DRIVEN MARKET SUSTAINABILITY. Corner & Randall (256, 2011); Whitmarsh, Seyfang & O'Neill (338, 2011)…

Risk of rebound effects: see p. 46.

Limits of spontaneous labelling. — 'Whilst the majority of consumers are likely to react positively to further carbon labelling of food products, this in itself is unlikely to drive much change in food systems. As such, the data imply that a concerted policy drive to decarbonise food systems via voluntary carbon footprinting and labelling policy initiatives is limited by a fragmented and haphazard market approach where retailers are being careful not to disaffect certain products by labelling others within the same category', Gadema and Oglethorpe warn (269: 815). Just like consumers won't look for an information if it is too costly compared to its utility, suppliers won't evaluate nor provide such information as long as it isn't in their interest: 'Profit-maximizing firms will thus weigh potential increased revenues against the cost of testing and providing information. In addition to directly increasing sales through higher consumer demand, however, firms also might benefit from improved relationships with regulators and other stakeholders that might positively impact profits in other ways':[253] reason why the policy makers must weigh in favour of labelling until the desired level of information is indeed provided. As Cohen and Vandenbergh point out,

> a traditional utility-maximizing model of consumer behaviour assumes that the rational consumer will choose a combination of price and quality that is consistent with her utility function and constraints. An important assumption of utility maximization is that consumers have perfect information about the price and quality they face. But although consumers easily can determine quality attributes, or 'search' goods, such as colour or size, they do not necessarily observe 'credence' goods—the ingredients of a product and their potential harm to the consumer's (or public's) health—either at the point of purchase or through casual experience [...] if the value of additional information exceeds the cost of search, they will demand this information and use it in their purchase decisions.

42. 281: 4.

> Consumer demand for information on credence attributes is also predicated on the assumption that consumers know this attribute exists and might vary by product. In other words, in order to demand information, consumers need to know the value of it.[253]

This is all the more true of CF, for it is not something consumers are used to taking into consideration *(see Fig. 14)*.

Carbon footprint being no real selling argument yet, it may either be disregarded, or only considered and labelled when advantageous economically, which is why 'classic,' for-profit supermarkets *also* go for such new trends [43]. The 'organic' market in France represented a 3.75 billion euros revenue taxes included in 2011, accounting for 2.3 % of the global French food market, against 1.3 % in 2007. [44] All other things being equal, carbon-low products are likely to always cost more: they may only be provided when, all other economical factors the same, they may become an actual criteria.

To Gadema & Oglethorpe (2011),

> the placing of labels on different product categories, as at present, only really serves to boost sales of those 'special' products rather than encourage a comparison within categories and thus risk increased sales of a product only at the expense of decreased sales of another. If labelling is really to be used to help consumers deliver a lower carbon food system, retailers (and their suppliers) will have to forego sales in high carbon products. To avoid this, what the retailers would need is an immediate and wholesale switch by all competitors to suddenly have all their products carbon footprinted so that the playing field was immediately flat and competitive again. This is clearly utopian. *(269: 821.)*

Imposing labels to all foodstuffs? — *Imposing* to all products a carbon label would probably give the best communicating results. As Gadema & Oglethorpe conclude, 'perhaps switching from a "softer" voluntary policy approach to a system that encourages uptake through mandatory measures amongst food supply chain actors is necessary to ensure widespread and simultaneous uptake, market proliferation and within-category labelling. This may actively facilitate a drive towards a stage where producers' claims of carbon consumption is commonplace, giving the food consumer more of an opportunity to differentiate meaningfully carbon footprints within same product categories.' (269: 821). It has already been considered in France,[424] but policy makers *1*, need not go so far to reach a satisfactory level of consumer information, and *2*, cannot bound to it *only*:

1. as far as an all-labelled policy goes, one must bear in mind the important *inertia* inherent to any labelling policy: not only is that which is labelled deemed good (up to that label's standards), but it is necessarily so *as opposed* to others which, without label, are deemed by elimination not as or less good: in marketing, no information means there is none flattering to give.[460]
2. Whether complete or partial, labelling isn't enough: part of the consumers cannot afford to respond to the market as they would like, whatever information provided and willingness on their side, lacking the mere economic *ability* to do so. In their case, the only option lies in putting under a correcting pressure the entire market, and make carbon-low products comparatively as or more profitable than others ('internalize the carbon externalities').

43. Auchan for instance, with Cœur nature.
44. Agence Bio, ⟨LINK TO ONLINE PDF⟩.

Labelling and labellings: the need for defined methods and harmonized measurements. — Paul Brenton et a. (347, 2008) also call attention upon the difficulties that as with PCTs policies, [45] currently jeopardize the possibility of a generalized labelling policy, which implications are not yet matched by the challenges of measurement and communication:

> Firms are eager to cater to consumers' demands and to reduce their own [CFs]. [...] retail giants, such as, UK Tesco or US Wal-Mart are developing carbon labelling schemes and major manufactures are following suite [...] But the strong desire to act on carbon labelling has been running ahead of the challenges of measurement and the problems of effective communication through labelling that must be addressed for schemes to be successful. [...] a growing number of standards are being developed with little effort to coordinate and generally little or no voice given to small players, such as, low income countries. *(347: 2.)*

Differences in revenue and the cost of diet shifts. — One might be led to believe that, as it is often said of the green market—and not without any irony towards the well-intentioned, changing-the-world-on-their-own rich organic buyers—that eating sustainably is likely to be more, if not much more expensive and unaffordable to the low income households. But such is actually *not* the case, when adopting a carbon footprint point of view. 'Interestingly, on a per expenditure basis, the impacts of all the other food groups (including the averaged restaurants group, which is low due to higher prices than eating at home) are remarkably similar in impact, though for different reasons', Weber & Matthews (2008) note. To which Vinnari & Tapio add that 'as in most environmental taxes, the apparent argument from traditional (human) welfare economic point of view is that increasing these taxes would affect more severely the poor than the rich. [...] this argument is more apparent than real — as long as there are large income differences the rich are always allowed to buy commodities that the poor are not. The income distribution is governed in the progressive (or non-progressive) income tax and capital gains tax' (451: 52).

The three customers clusters. — As D. Huffman (2010) writes,

> Delineating people into lifestyles is an inherently complex matter since it is, generally speaking, impossible to pigeonhole people. Lifestyles tend to overlap [...] However, as stressed before, the idea of linking lifestyles with products to make them more sellable has been proven by the success businesses have had with this approach. Overlapping lifestyles is no longer an issue since a company only cares about the particular lifestyle that is of relevance to their product. Inasmuch, the concept of lifestyles can be said to be more useful than it is explanatory *(281: 17.)*

Gadema and Oglethorpe (2011), asking a series of questions on what criteria they used to purchase food *(see Fig. 14)*, have delimited three customer clusters. When asked about carbon labels, '80% of Cluster 1 [36% of the sample] thought it either very important or important, whilst 52% of Cluster 2 [45% of the sample] thought it important, the rest either not knowing or thinking it unimportant and the majority of Cluster 3 [19% of the sample] thinking it not important' (269: 819), *but* even among cluster 1, and although identified as

> as a group [which] clearly tried to seek as much information about their food as possible[, and although their] highest priorities for information seeking were multiple, including free range and organic status, the sustainability of food sources, fair trade, sustainable packaging, local provenance, nutrition and quality[, all]

45. See p. 48.

> of these factors [influencing] on a change in their priorities on what food they buy[, a] notable exception to this list, however, is carbon and on aggregate, the majority of the Cluster have not changed their priority of purchases in reaction to carbon labels. However, closer inspection shows that this is a slim majority and 44% of the Cluster have changed shopping priorities as a result of seeing carbon labels on products. *(269, 819.)*

INFORMATION, WILLINGNESS AND ABILITY. THE IMPERATIVE OF A SOUND, ALL-INCLUSIVE POLICY BEYOND MARKET APPROACHES Should low-GHGs products be seen as systematically too costly, the risk would be to have them assimilated to a luxury niche market, and people would disregard them. 'Consumers need to be able to access the information, but also be willing to take part of it', D. Huffman (2010) writes, reminding that consumers can never be treated as a homogenous group: 'The fallacy of approaching consumers in this way is that a one cap fits all policy is less likely to lead to success than a policy whereby carbon labelling is adapted to the reality of a landscape in which consumers are segmented.' (281:12).

The less favoured of French households can spend up to 50 % of their revenue in food, against an average of 15 %.[10] Dietary conceptions and practices must not become more of 'social class thing' than they seem to have increasingly become[29] through a yuppified, exclusive rich green and organic market.

'Les consommateurs placent en effet l'assurance d'une absence de surcoût au premier rang des évolutions à réaliser pour encourager le choix d'un produit vert' (424: 4).

AN INSUFFICIENT, YET PARAMOUNT AND URGENT FIRST STEP TOWARDS CONSUMERS' SUSTAINABLE CHOICES Be it obviously unrealistic to rely entirely on it, the step of carbon labelling is of the utmost importance on the path to sustainable food chains. In the wait for more voluntary decisions and in the face of climate change determinants current curve, 'waiting for a "best" policy may increase the likelihood of severe impacts' as Vandenbergh et a. (2011) write, and the policy challenge is to develop near-term strategies that can bend the global carbon-growth curve to buy time, reduce costs and build support for more efficient approaches' (447: 4).

'It is not reasonable to expect labelling to solve a complex problem by radically shifting the behaviour of most or all consumers. It is reasonable, however, to expect that labelling may improve a consumer's ability to make choices and may induce firms to change the mix of products offered to consumers. Nutritional labelling, for example, has not eliminated diet-related health problems, but labels do influence product selection and consumption in some cases [...] evidence suggests that consumers have modified purchasing behaviour in response to non-nutritional labels such as "dolphin-safe" tuna labels [...] Of course labelling and certification systems do not always fully achieve their goals. However, the existence of shortcomings does not obviate the value of such a programme. The relevant question for non-governmental carbon labelling is not whether it is better or worse than ideal but hypothetical alternatives, but whether it should be one of a cluster of viable private-governance options that are pursued in the absence of more efficient and comprehensive approaches.' (447: 5).

> A concern is often expressed that private efforts to promote reductions will undermine more effective public measures. This argument is well taken, but the prospects for major national and international actions beyond the European Union seem poor. The opportunity cost for non-governmental organizations of a global labelling system also is remarkably small—in other words, the same amount of money spent on other carbon-reducing efforts is unlikely to yield greater benefits, at least in the near term. The Marine Stewardship Council seafood- labelling system operates on roughly £8 million per year of private

> funding16. A carbon-labelling system may have higher start-up costs, but not by more than an order of magnitude. At this point, with the theoretically ideal measures (such as a carbon tax or cap-and-trade system) not under active consideration globally, it is appropriate to seek a portfolio of measures in the hope that a combination will enable us to avoid crossing important thresholds. As with renewable portfolio standards or policies to encourage energy efficiency, labels alone are not sufficient to meet frequently stated targets. But they can play an important role in the near term, and the information they provide can complement carbon-pricing approaches in the long term. The size of the consumer footprint suggests that only small shifts in purchasing behaviour could yield large emissions reductions. *(447: 6.)*

4 Making things effective: policy perspectives for sustainable food consumption

As we have seen, mere informational schemes and labelling policies are most likely to prove insufficient to get the change needed on the move. And although a majority of (numerous and growing) recent research and concern over the food sustainability issue have and still almost exclusively concentrate on 'raising awareness' and developing informational schemes, more political, voluntary and potentially effective options have been evoked and models built, such as taxation and PCTs.

INEVITABILITY OF REBOUND EFFECTS? RECONSIDERING AGRICULTURE WITHIN ITS THE POLITICAL LEADERSHIP While M. Berners-Lee (239, 2012) contemplated an ideal 'all vegetarian' option and thus claimed diet shifts could '[be] equivalent [for the UK] to a 50 % reduction in current exhaust pipe emissions from the entire UK passenger car fleet,' analyses such as Tukker et a.'s (198, 2011) show less optimistic results, concluding that the more realistic

> Changes to healthier diets without significant meat and dairy intake reductions would result in rather minor reductions of environmental impacts in Europe. Dietary recommendation scenarios that reduce significantly the intake of red meat [...] can lead to a reduction of impacts of food consumption by about 8%, or about 2% of the impacts of final consumption in Europe of all goods. This conclusion also holds when first order rebounds (or income effects) are taken into account. Modeling of secondary rebounds (changes of production structures) [...] suggests however that European production of food items like beef will not drop in line with domestic final consumption. The European meat production sector will most likely respond by higher exports to compensate for losses on the domestic meat market. This hence implies that impacts in Europe will drop even less. *(198: 1783–1785.)*

Thus dietary shifts alone might well cause, because of important rebound effects, our 'turning lights into flights', as Chitnis et a. write (251, 2013). Vandenbergh et a. (2011) also warn that 'the purchase of low-carbon products may lead people to take additional "green" actions or it may give them a sense of license to increase carbon emissions through other activities [...] The net effect is key' (447: 5). Yet, Vandenbergh et a. warned against the risk of delaying or expecting 'perfect policies' that never come, and both M. Berners-Lee and Tukker et a. say the shift towards alternative diets is recommendable, and for a large variety of reasons, within and beyond the sole 'environmental'.[198]

But more importantly, although rebound effects are a difficult issue to tackle within a free-trade, WTO-led world, one should not overlook how sensitive the agricultural sector is to political decisions, and how much it relies on public subsidies and political orientations. As Vinnari and Tapio (2012) rightly point out,

> Forty percent of the entire EU budget is formed of subsidies to agriculture and fisheries [...] whereas agriculture accounts for only about 1.3% of the EU–25 countries' GDP [...] Although the agricultural sector has faced many changes, it has become very subsidized and filled with market restrictions, such as tariffs or import quotas. As such nobody has plausible knowledge about what the price of foodstuffs and what the share of national agricultural production would be in a hypothetical open market. *(451: 47.)*

IS THERE AN 'ENERGY USE KUZNETS CURVE'? RECONSIDERING THE TERMS OF THE POLITICAL

TRADE-OFF Whether or not government should undertake ambitious prophilactic policies or let people indulge in damaging consumption patters is not ours to discuss; but policy makers and citizens need to know that sustainable diets are just as sustainable for the environment as they are to ourselves. The legitimacy of a political guidance, considering the stakes, cannot be overlooked in the name of free trade. If such policies have hardly been considered out loud yet, it is important to bear in mind both upstream and downstream available measures to influence the reform of food chains.

Most importantly, political involvement is not only necessary to both the environment and public health, but it may well not at all be badly perceived on the long run, and no longer seen as constraining passed a first 'painful' transition. Indeed Marta Rivera-Ferra (425, 2009) has suggested that meat and environmentally heavy foodstuffs consumption may be supply more than demand driven.

4.1 Goodland's (1997) Pigouvian food conversion efficiency tax

For a cause study in Denmark, see e.g. 262

In carbon taxes have been thought of as soon as the late 1970 and 1980s (370: 242), the idea for food originates in the very article which founded the reflexion on food sustainability: Robert Goodland's 1997 'diet matters' article. Having established that enhancing the production schemes will not prove sufficient to address the population's increase and would moreover, to the extent possible, have additional negative consequences on the environment; having reminded the health issues linked to food and the benefits to expect, he goes on contemplating the means of addressing diet issues through a for conversion efficiency tax that should have a relieving effect on land use and preserve food chains from being overloaded by too 'greedy' diets. 'Just as society taxes fuel inefficiency in cars, so with conversion efficiency in food', starting with ending subsidies to carbon-intensive agriculture, financing information campaigns as well as redirecting research (120: 197). And it is worth noting that his attitude here is both responding to environmental and social equity concerns: 'the taxes and other incentives proposed [...] seek to ensure that people eating high up the food chain pay the full environmental and social costs of their diets' (120: 196).

PRINCIPLE AND EXTENSION Goodland leaves the precise methodology and nature of the incentives of his suggested tax for economists to debate (120: 197), but presents its general inspiration as follows:

> In order to reduce food wastage and to improve health and food availability, a food conversion efficiency tax is proposed. The least efficient converters (pork, beef) would be highly taxed; more efficient converters (poultry, eggs, dairy) would be moderately taxed. Most efficient converters (ocean fish) [46] would be taxed lowest. Grain for human food would not be taxed, while coarse grain might be modestly subsidized. Non-food agriculture would also be taxed: highest on tobacco and on starches destined for alcoholic beverages produced from land suitable for food production. *(120: 189.)*

Eventually, not only would cropland be redirected to the less intensive diets, but 'land allocated to the production of products other than food will increasingly be decreased to the extent possible,' among which tobacco, but also cotton, and potable alcohol crops, assessing for each, int he case of cotton and other basic needs goods, the environmental trade-offs of the respective uses. The same would of course be applied to account for different agricultural methods:

46. Later on, Goodland also notes: 'Higher taxes would be levied on animals over-harvested such as whales on most major fishery species' (120: 198).

> This conversion-efficiency sliding-scale tax should be refined by adding the 'polluter pays' principle. Polluting cattle feedlots and meatpackers would be taxed highest; domestically-fed rodents and lagomorphs the least. If biodiversity and habitat destruction are included in environmental damage, then cattle raised from pastures created from rainforest would be taxed highest. Natural range [...] would incur a lower tax. *(120: 199.)*

(Goodland did not include the problem of the carbonic trade-off in between countries due to different climate and release/uptake possibilities which we considered p. 27: that would need to be amongst the top priorities for measuring and establishing trade-offs).

TAXING AND TRADING IN RETAIL SHOPS

> For a significant drop in the consumption of foods reputed to be bad for health [...] the tax needs to be high (threshold effect), which would penalize the consumers who have no choice but to buy these inexpensive products. These interventions on supply can also have undesirable effects: lower nutritional quality of ingredients used, move towards budget products etc. *(10: 105.)*

TAXING AND TRADING OPTIONS WITHIN AGRICULTURE Petersen et a. (421, 2003) have shown that to mitigate the emissions of the predominantly grazing Australian agriculture, taxes prove no to be an option, for they would only reach sufficient mitigation effort when agriculture is no longer economically viable. Emissions restrictions are found to '[allow] farms to remain profitable at approximately four times greater abatement levels than the taxation policies, and [...] to be the most effective and efficient policy option studied', despite unpopularity, and the risk of failing for farms unable to adapt in the absence of swift and innovative technological change, causing them to be replaced by alternative land-uses.

Flugge & Schilizzi (378, 2005) reach the same conclusions, grazing or cropping alike.

Yet it is untrue to argue that such taxes cannot be put into place for logistical reasons. As Goodland points out, 'only four meatpackers in the US hold 82% of the market, so that might be a low cost place to tax,' and the same goes in most countries (120: 197). Additionally, on the up-stream part, 'if taxing grain becomes necessary in the future i order to foster only its most efficient uses, such a regressive tax should be balanced into neutrality by reducing income taxes commensurately. Higher priced grain would then automatically go to the more efficient users, namely feeding people' (120: 197).

4.2 Personal carbon trading policies: too soon?

'There is little literature on carbon rationing and related ideas' (371: 1486), and most of it is the work of Tina Fawcett.[371–376] Whilst warning against too early, overly improvised case programs,[372] she has shown that contrarily to what the UK's government concluded in 2008 Personal carbon trading (PCT) policy wasn't 'ahead of its time',[47] and that if it would indeed cost more than a mere taxation policy to implement and 'gaining public or political support for a scheme like carbon rationing is far from assured' (371: 1486), 'most research shows PCT to be at least as socially acceptable as an alternative taxation policy. People think it could be both

47. 'The findings of the research indicate that, while personal carbon trading remains a potentially important way to engage individuals, and there are no insurmountable technical obstacles to its introduction, it would nonetheless seem that it is an idea currently ahead of its time in terms of its public acceptability and the technology to bring down the costs. There are some significant challenges to its potential as an effective policy tool, and these would need to be addressed before this option could be considered as a part of the UK's Climate Change Programme' (356: 4, ref. to in 373: 6868.)

fair and effective',[373], [48] Can they be the 'third wave' of green trading?[382] Fawcett's studies do not consider the possibility of a carbon-food rationing scheme, but we may build upon her work, especially since she provides interesting comparisons between these schemes and World War 2 rationing measures, which did concern food, and the same foodstuffs which would be controlled now: meat, bacon, cheese, fats, sugar (370: 243).

MAKING THE CASE FOR PCT: THE RAISON D'ÊTRE OF CARBON QUOTAS Fawcett's case for carbon trading lies in the observation of the 'history of failure of energy efficiency over the past thirty years to deliver actual energy savings [...] Recent policy is simply a continuation of previous policies with no guarantee that it will be any more successful' (371: 1483), because of the importance of rebound effects, causing the UK's emissions *per capita* to vary from 1 to ten. Although Fawcett's study is set around the UK case, the problem is largely shared, and 'the idea [...] is relevant for all EU countries'.

Although technical improvements have a role to play, 'experience over the past thirty years would suggest [...] that in reality there is a very high risk that carbon savings will not be delivered through efficiency alone' (371: 1484), and this is particularly true of food chains, which are not included in Fawcett's works, focusing on fossil fuel use, but could be (370: 240).

PRINCIPLE AND EXTENSION '[PCT] is an umbrella concept which covers a number of specific policy proposals [...] The common features of all PCT schemes are: rights for carbon emissions are allocated to individuals for free; emissions from household energy use and/or personal (i.e. non-business) transport are covered; emissions rights are tradable; and emissions allocations reduce year-on-year in line with a declining national carbon cap' (373: 6868)

Carbon rations specifications are defined as follows (371: 1486):

— 'equal rations for all individuals'

— 'tradable rations'

— 'year-on-year reduction of the annual ration, signaled well in advance'

— 'personal transport and household energy use included'

— 'a mandatory, not voluntary arrangement'

PCTs being then integrated into a more global, contraction and convergence policy [49] (370: 239).

In the UK, such measures would concern, if including transport and household energy consumption, 42 % of total GHGs emissions [50], and, '50 % if the non-carbon climate impacts of air travel are included'[373]

ISSUES AND CONCERNS Fawcett lists:

1. 'the unfairness of putting the burden of responding to climate change directly on individuals, and the many difficulties they may have in responding to limited and reducing emissions'
2. 'the inequality of giving people equal rights to carbon emissions / allowing trading so that richer people can buy the right to emit more carbon'
3. 'carbon rationing is an unnecessary policy—carbon taxation should be the preferred solution'

48. See also 435, 436, confirmed by 247.
49. See below, p. 54.
50. 459, quoted in 373: 6868. F. refers to 459's Fig. 7.1, p. 237.

4. 'the administrative challenge and the cost of implementing such a system'
5. 'the (im)possibility of getting public or political support for such a radical idea'

As for 1, although it may be debated in Fawcett's studies, no such concern makes sense in the case of food, since it always eventually relies on personal decisions.

As for 2, Fawcett notes that as carbons rations would be tradable and richer households on average consume more, they would rather be an income source, not to mention the much greater and guaranteed inequality which implementing taxing would result in.

As for 3:

> Meyer (400: 54) identifies two major problems with carbon taxes. Firstly, they hit the poor in any country more harshly than the rich, since the less well off spend a greater proportion of their income on buying [carbon-intensive products, fuel, in Fawcett's example]. Secondly, their effectiveness varies according to the trade cycle—a tax rate that achieves its objective in limiting emissions in a period of strong economic growth will be much too harsh when that same economy is in recession. By contrast, rationing has the advantage of certainty of result, it is clear exactly what carbon savings will be made. In addition, [...] Domestic energy taxation is seen as inherently unfair. Taxation does not have the same moral basis as rationing, it allows those with higher incomes to pollute more as of right. *(370: 242.)*

And, more significantly, if 60% reductions in GHGs must be achieved within 2050, one may wonder what levels of taxes would allow such drastic shift, as opposed to an equal and progressive rationing scheme.

As for 4, Fawcett claims that 'Virtually all transactions could be carried out electronically, using the technologies and systems already in place for direct debit systems and credit cards'

As for 5, one must see that PCT is the only scheme likely to succeed in getting popular and hence political support: all being equal, it is, in a word, 'a good democracy' (370: 240). Besides, the expected decrease *per annum* is only 2%, a very 'acceptable' figure, and after a 'getting-used-to' period with no reduction goals (370: 242).

The comparison between Fawcett's and a food rationing scheme comprises both differences and similarities, both positive and negative:

— although it would make little sense to compare the nutrition of the time and ours, for little is to be achieved in terms of fighting under-nutrition, it is fairly reasonable that through lowering fat intake, such measures would also result in overall improved nutrition (370: 243);

— food is likely to be considered much more intrusive than, say, electricity consumption. But one must see that 'fossil fuel energy use underpins most aspects of modern life, including growing and importing food, so making the transition to a lower carbon society is clearly an immense task,' (370: 243) which as we have seen would eventually need to include food chains;

— during wartime, rationing did actually prevent people from going hungry. No such effect would be felt today, at least not as of national consumption. But they may have tremendous importance internationally;

— most importantly, rationing schemes were only agreed with as part of a temporary, compulsory effort; there is no guarantee that popular support will meet such a proposal as a permanent, and growing-over-time constraint (370: 243);

— inequalities in social organization due to different needs (the 'household effect') would cause a flawed equity towards single-person households. Here it is important to note

that most foodstuffs, being below the 'carbon-intensive threshold', would remain off-rations. Additionally, 'perfect equity is not needed for a system to be seen as fair', and instead of generalized varying rations, those with special needs could be granted additional rations (370: 247).

— while savings in energy do not affect all equally, as being energy-efficient per unit requires investments, such revenue disparities do not exist with food, since provision of foodstuffs and GHGs do not vary on a 'kitchen basis.' In the case of energy-savings, Fawcett sees no option of equalization but to rely on government financial involvement. No problem of food equality exists when looking at GHGs: again, meat set aside, 'on a per expenditure basis, the impacts of all the other food groups (including the averaged restaurants group, which is low due to higher prices than eating at home) are remarkably similar in impact, though for different reasons'.[206]

POSSIBLE ALTERNATIVE IMPLEMENTATIONS OF TRACKING FOOD As with Berners Lee's idea of giving consumers carbon 'guesstimates,' PCT offers a fair and effective way to push for carbon-sober behaviours; but these would still need informational help.

> Many social, technical and policy innovations would be needed to make it easier for people to live within their carbon rations. On the technical side, innovations could include 'smart meters' which informed people how much of their carbon ration for that year was left, which appliances were using most energy, how much carbon could be saved [through . . .] *(370: 242.)*
>
> What would carbon rations mean for existing policies? If the responsibility for choices on carbon are being given to the consumer, then the level of information and education on carbon issues will have to increase drastically. We could look at the scale of education and information provided on food rationing in the second world war to see how to proceed. People weren't just given food rations and expected to adjust. There was a comprehensive information campaign using radio, magazines, leaflets, posters and so on giving recipes [. . .] suggesting how to economise with food while still providing healthy meals and persuading people to 'dig for victory' [. . .] Enabling people to live well on food rations was a key government aim and taking pride in doing so became part of the national culture. *(370: 247.)*

Flashcodes,[424] as already done by several companies in the US and UK,[447] and in France by TOWT.

4.3 Vinnari and Tapio's governance model: towards a state-directed food sustainability?

Comparing the existing sustainability philosophies at work and their suggestions regarding sustainable food chains, Vinnari & Tapio (451, 2012) advocate for what they call a 'deep modernization' approach. To lower meat consumption and push for more sustainable diets, two state-directed models are presented to reduce the consumption of environmentally harmful foodstuffs. The first one builds upon Goodland's 1997 Pigouvian tax, presented above, including an animal welfare ethical considerations. Though acknowledging that 'the taxation of meat per gram is by no means an optimal method for animal welfare improvements since it directly affects quantity instead of quality [. . .] However, it can be an efficient way to guide consumer decision-making—if the taxes are set high enough' (451: 52). (Problem which, that is worth noting, is more than just 'quantity' against 'quality' in terms of animal welfare, for it is known

that intensive livestock systems have lower emissions than extensive, pastoral systems—see e.g. 153, fig. 3 p. 6.)

Additionally, since such a tax would only be an added layer of complication to an already highly subsidized sector, they also suggest redirecting these subsidies towards less meat-intensive agricultural practices:

> This system is proposed as the agricultural sector is currently so heavily subsidized that taxing the subsidized system, as proposed in the previous chapter, would make it only a more complicated one. The proposed system could be used as a simple way to grant subsidies to farmers and it would add to the transparency of the whole agricultural system. *(451: 51.)*

Vinnari & Tapio's suggestion builds upon the Finnish government's Decision on Safeguarding the Security of Supply, in which 'the objective is to reach such a degree of preparation that the population's capacity to make a living, to carry out necessary social activities and to achieve the material preconditions for an effective national defense are not endangered', a strategy which of course includes food (451: 51). They suggest the calculus of a nutritional standpoint to evaluate a national stockpile's food needs, to which is added an 'ethical' value to foodstuffs, thus reducing the share of meat up to what the population deems ethically acceptable. Upon a first look, this suggestion seems both common sense…and urgent: as Goodland pointed out already back in 1997, due to meat consumption rising, 'global grain reserves fell to an all-time low in 1995 [at a point when half the grain was directed to livestock, according to the FAO]. At the end [of that year,] grain carry over reserves dropped to 231 million tons, enough to feed the world for only 48 days' (120: 191). And as consumption patterns evolve, this is of growing concern. In Vinnari & Tapio's model,

> The next step is the agreement by governments to buy the produce. The buying price should be higher than the market price, and the subsidies given to agriculture would be paid as the compensation between the production price and the buy-in price. The government would sell the produce to the highest bidder on the global market. This system would strongly support environmentally efficient production and also recognize ethical aspects. *(451: 51–52.)*

To the authors,

> The benefits of the proposed system could include: 1) The composition of national stockpiles that would secure food distribution also in the occurrence of crises or disasters; 2) Securing a national level food production in each country; 3) Stabilizing food prices so that producers can be certain of market demand for the products in the national stockpile; 4) The simplification of the current agricultural subsidy system; 5) The guiding of consumer behavior through the directing of subsidies to the environmentally least harmful products and away from animal derived foodstuffs; 6) Securing a wider selection of foodstuffs in the global markets, especially as the national stockpile composition would result in broader and more distinctive compositions of national stockpiles in different parts of the world. *(451: 52.)*

LIMITS TO A SOLE STATE-DIRECTED MODEL Two problems at least lie in this approach:

1. a first and somewhat too obvious question is that of the 'politically and legally achievable' by governments in liberal and globalized economies of such a much more directive state-controlled system than the other policy options contemplated, the current purely quantitative subsidies granted, and the shyness towards normativeness which, to date,

characterizes food policies. Ideally, advanced international cooperation will be required whatever the scenario, but since important trade issues are at stake, the question of the degree to which 'national stockpiles' controlled by states are compatible with free-trade policies within a cooperation framework also needs to be answered.

2. the population is assumed to be genuinely concerned with ethical issues, and globally ready to sacrifice its dietary patterns to moral considerations—namely, 'the granting of inherent value to living entities other than humans[, which] would mean that the end goal would be a society that would abandon almost all meat eating; a nearly vegan society' (451: 52)—: it takes for granted a willingness on the part of the consumer which as we have seen isn't at all to be taken for granted, nor all that easy to raise. True, a state-operated agricultural 'partition' would, to an equal 'awareness level', prove much more efficient in translating ideas and concerns into 'buycott' and concrete agricultural changes, but one cannot take for granted that such an option is likely to be acceptable on the part of citizens, be they concerned by the question, in the face of more liberal, labelling schemes. Besides, to not be of 'second importance,' it is not said that it need come into the picture outside of the individual sphere: thus Goodland, whilst acknowledging its importance, left it aside in his founding article[51];
3. *all* governments must take part in the trading system. If not, the risk is that retailers would buy to other, 'conventionally' subsidized sellers on the market, and agricultural issues would again just be displaced out of the country, as Tukker et a. (2011) feared (see p. 46): globally, GHGs emissions would thus only be likely to raise: no diet shifts would take place whilst transportation would increase. True, Vinnari & Tapio do admit their system does not account the 'food miles issues', and remind its very relative importance as contributor to GHGs; but they fail to see the problem of land use, which cannot be dealt with at any other but the global scale. For the only solution would then be to prevent such 'other ways' through tariffs. No to mention it being, again, a violence done to freedom of exchange, such policy could be plausible at say the European scale—as is already done to quite an extent for economic reasons—, but once more to some extent only, as not all foodstuffs can be produced at the regional level. Implemented at any smaller scale, it would just mean coming down to the autarky fantasy Gordon Brown warned about (see p. 32). A contraction and convergence policy is not only more efficient in theory, but much more realistic altogether. As for the authors' idea that 'a government would offer to buy the cheapest products that fulfill the nutritional requirements of a country from producers within it, and, if the government was unable to sell them within the country, it could sell them on the global market. The premium between the buying price and selling price would act as a subsidy that secures national production,' it also raises questions: granted, it would at first glance prevent export-directed land use detrimental of locals' agriculture, and as such does represent an important food security measure; but although directed to inland consumption, it is not certain that the *producers* could 'afford' to be locals, as the more intensive and cheapest practices are not at the disposal of the average peasant in most countries. Additional trade-offs would then again be needed, risking the system to be no less complicated than the other subsidies practices currently in use.

Unless a big conscience shift is achieved beforehand or parallelly on the part of the consumers and global cooperation policies implemented, this suggestion is also clearly utopian, and by no means an environmentally optimal solution if achieved in isolation from the global

51. 'the powerful ethical argument for promoting environmental sustainability by adjusting diet is left until later,' he writes, pointing that 'where individuals are comfortable on this continuum [of omnivorous-veganism] is for each individual to decide, that is not the main issue here' (120: 190 and 196).

food flows and global land use and agricultural issues. True, it may well be a solution if no other is applicable, but it is hard to believe that any government would implement it in total isolation from others—that is, as long as food security is guaranteed.

4.4 The case for a contraction and convergence policy

Here again we fall back upon Goodland's 1997 suggestions: 'for the world to remain low down the food chain, [it is important] for those high to descend, and to discourage people from moving up' (120: 191). In terms of policy and international cooperations, this means a contraction and convergence policy. McMichael et a. agree that 'urgent attention needs to be paid to finding ways of reducing the demand for animal products and the energy intensity of their production,' but rather than Vinnari & Tapio's somewhat very imaginary model, their suggestion fits more into the current framework of environmental policies:

> a contraction and convergence policy [...] seems to be the most defensible—and therefore the most politically feasible—model for restricting emissions arising in relation to consumption of meat and dairy products. Because rapid reductions in [GHGs] emissions per unit of livestock production would be technically and culturally difficult in the short term, the prime objective must be to reduce consumption of animal products in high-income countries, and thus lower the ceiling consumption level to which low-income and middle-income countries would then converge.
>
> The main options for reducing greenhouse-gas emissions per unit of animal production include: (1) sequestering carbon and mitigating carbon dioxide emissions by reduction and reversal of deforestation arising from agricultural intensification and by restoration of organic carbon to cultivated soils and degraded pastures; (2) reducing methane emissions from enteric fermentation (especially in ruminants such as cattle, sheep, and goats) through improved efficiency and diets; (3) increasing the proportion of chickens, monogastric mammals, and vegetarian fish in the flow of animals grown for human consumption; (4) mitigating emissions of methane through improved management of manure and biogas; and (5) mitigating emissions of nitrous oxide via more efficient use of nitrogenous fertilisers.
>
> [...]
>
> Against the argument that contraction and convergence would not work because of strong consumer preferences for meat we argue that the unprecedented serious challenge posed by climate change necessitates radical responses.
>
> *(153: 8–9.)*

To push for reduction trends within developed countries, McMichael et a.'s solution actually joins part of Vinnari & Tapio's case model: 'removing state subsidies for animal feed (corn and soy) would, via increases in retail prices, help to reduce meat consumption and redirect grain harvests to local low-income country diets' (153: 10).

The idea behind convergence and contraction. — First proposed by the Global Commons Institute in 1990,[400] and integrated in Fawcett's model (371: 1486), it consists of:

— 'Contraction: an international agreement is reached on how much further the level of CO_2 can be allowed to rise before the changes in the climate it produces will become totally unacceptable. Once this limit has been agreed, it is possible to work out how quickly current global emissions must be cut back to reach this target. This cutting back is the contraction part of contraction and convergence'

— 'Convergence: Global convergence to equal per capita shares of this contraction, by an agreed year' (370: 240).

As C&C is designed to discourage poor countries to go 'the fossil way' through the financial incentive of buying to dependent rich-countries which haven't yet done their transition.[400]

Including international equity. — We have seen that the carbon uptake/release and cropland productivity trade-offs of land use being different along the latitudes, the benefits to gain from non-use of forest and cropland needed curtailing agriculture in some regions more than others, and compensation mechanisms would then have to be debated. The same goes for meat-reduction, McMichael et a. note:

> An important issue of international equity [...] arises. Although developing countries now account for about two-fifths of global emissions of [CO_2], they produce more than half of nitrous oxide and nearly two-thirds of methane emissions. The largest share of livestock-related [GHGs] emissions comes from pastoral production systems, with which many rural livestock holders, operating on a small scale, eke out livelihoods from limited natural resources. Such individuals currently lack the money to upgrade production methods to lower-emission standards. Yet, since most of the huge projected increase in global meat production and consumption is expected to occur in developing countries, the more [GHGs]-intensive traditional rural production methods will come under increasing competitive commercial and regulatory pressure, even though their methods entail fewer distortions or violations of natural processes. Equitable resolution will require enlightened national government policies, international trade, and other agreements. *(153: 9.)*

4.5 Review of current programmes and norms

Current pilot programmes of carbon labelling of products: UK, Switzerland and Japan, among others, that could be expanded.[446]

REVIEW OF CURRENT AND EXPECTED NORMS International norms include ISO 14021 (Environmental labels and declarations—Self-declared environmental claims, 1999), ISO 14020 (Environmental labels and declarations—General principles, 2000), ISO 14025 (Environmental labels and declarations—Type III environmental declarations—Principles and procedures, 2006) and will soon include the already belated ISO 14067, 'to enable worldwide comparability of carbon footprint data.'

A REVIEW OF THE UK EXPERIENCE Gadema and Oglethorpe (ref. 269, 2011) have studied the carbon labelling policy and effects in the UK, where the 'Framework for Environmental Behaviours [...] strongly advocates a social marketing approach' and wondered if such was 'a sensible way of trying to achieve to a low carbon future' (269: 815). They concude that 'whilst consumer demand is relatively strong for carbon labels with a stated preference rate of 72%, confusion in interpreting and understanding labels is correspondingly high at a total of 89%, primarily as a result of poor communication and market proliferation'.

'NUDGE COMMITTEE': PUSILLANIMITY TOWARDS NORMATIVENESS? 'Perversely, these more sociological theories of consumption—with a few notable exceptions—have tended to shy away from an explicit concern with "sustainability", eschewing in particular its normative agenda [...] the real challenge of sustainable consumption is confronting the tension inherent in the idea of sustainable consumerism and suggest some strategies for resolving this tension'[369]

UNEP (2005) emphasized the role of marketing, whilst acknowledging its many limits.

NOTIONS AND MEASURES *(See Fig. 25.)*

IN BELATED FRANCE In France, legal commitment to trying carbon labelling started no sooner than 2010, beginning past mid-2011, and was only an experimental incentive, art. 228 of the loi n° 2010–788 du 12 juillet 2010 portant engagement national pour l'environnement modifying the Code de la consommation's article L112-10 to

> À partir du 1er juillet 2011, et après concertation avec l'ensemble des acteurs des filières concernées, une expérimentation est menée, pour une durée minimale d'une année, afin d'informer progressivement le consommateur par tout procédé approprié du contenu en équivalent carbone des produits et de leur emballage, ainsi que de la consommation de ressources naturelles ou de l'impact sur les milieux naturels qui sont imputables à ces produits au cours de leur cycle de vie.

As for 2013, it has been recommended that a mandatory label on all daily consumption products be put in place within 3 to 5 years (424, proposal 1).

So far, though the sales of eco-signaled products have grown by 15 % between 2008 and 2010, and 70 % of consumers claim they recognize eco-labels, only about a third claim they can tell the environmental impact of their purchases.[424] The most commonly recognized labels, AB and the European biological agriculture logo, aren't eco-labels per say, since they do not take into account any life cycle analysis.[424]

52

52. ⟨URL⟩.

Some French supermarket chains have begun carbon-marketing, like Leclerc since june 2008[53] printing CO_2e information on bills, and Casino, which begun its carbon impact study in 2004, displayed a carbon indices on some products in some stores[54] both with support from Ademe[55].

International Urban Food Network, ⟨http://fr.iufn.org/⟩

53. ⟨URL⟩.
54. ⟨URL⟩.
55. See ⟨HERE⟩ for Leclerc supermarkets, ⟨HERE⟩ for Casino.

4.6 Beyond carbon and climate: other impacts induced by a sustainable food consumption

'VIRTUALLY EVERY MAJOR CATEGORY OF ENVIRONMENTAL DAMAGE' 'Expansion of food supply under any scenario makes the environmental impact of agriculture one of the most urgent and under-addressed predicaments of our times' wrote Robert Goodland in 1997 (120: 190). More than a decade later, not much change has been achieved.

LAND USE AND BIODIVERSITY

> South America saw a striking expansion of agricultural lands during recent decades. However, the total cropland requirements for food for this region did not increase greatly since 1980. Much of the expansion was indeed export-driven and used to provide for part of the increases in land demand elsewhere, e.g., in Eastern Asia. *(133: 6871.)*

349

Deforestation and indigenous people. — Coomes, Grimard, Potvin & Sima's article 'The fate of the tropical forest: Carbon or cattle?' (354, 2008)

WATER If meat consumption habits remain, 'the rich countries will be able to buy their way out of the dilemma by importing "virtual water", that is, food (cattle feed or meat) from other countries, even from water-poor ones' (69: 7).

Voir 380, ref. nº 17.

'Substantial and widespread public-health problems of under-nutrition and over-nutrition exist—often coexisting within the same population' (153: 1). As 13% of the world's population still suffer from hunger (850 million people), McMichael et a. (2007) go on writing, alimentary fairness remains of the greatest international issues to tackle, and tightly linked to that of sustainable food chains:

> Although this topic is beyond the scope of this paper, we note that today's combination of a globalised economic system with persistent economic disparities between rich and poor, and the depletion of the environmental resource base for food production on land and at sea, militates against reduction of this basic public-health problem. *(153: 2.)*

ON FOOD ISSUES AND ALIMENTARY FAIRNESS AND TRADE Meat is responsible for higher prices of basic foodstuffs;[120,481] and in the 1980s already, the UN world Food Council calculated that '10–15% of cereals now fed to livestock is enough to raise the world calorie supply to adequate levels.' [56].

Despite its many limits, Vinnari & Tapio's (2012) model does cast light upon the issue of food inequalities between and within countries.

HUMAN HEALTH. TAKING A NEW LOOK AT PROPHYLACTIC POLICIES 'It is now clear that diet is one of the leading causes of ill-health in our society, with our current patterns of food consumption leading to thousands of early deaths each year', Gordon Brown writes (351: i).

56. Quoted in 120: 1995

Given both the human and environmental cost of bad diets, implementing a prophylactic policy answers questions of social and environmental international fairness as well as public health issues.

Review of some benefits and literature on health and meat consumption reduction: 153: 8 *sq.*

Conclusion.
Understanding the stakes, nuances and subtleties of the sustainable food consumption debate

The sustainability of food chains is an eminently complex issue, involving many actors, action levels and a large variety of parameters. Though not bad *per se*, the debate cannot be limited to the spurious ideas of an 'all organic' or 'all local' agricultural future, nor can it be met by solely technical improvements. Diet shifts are mandatory, but no key determinant can be made the one decision factor, as all have a very relative importance, changing with each foodstuff, production method, location and season. Yet, patterns do emerge that can lead consumers though otherwise very difficult and delicate evaluations, and several policy measures have been thought of that could provide the needed incentives towards better food chains. These are not all easy to implement, but much can be done through simple and efficient measures, such as redirecting agricultural subsidies.

IS THE DIET SHIFTS CHALLENGE SUCH A BIG DEAL? DO WE ACTUALLY LIKE OUR DIETS, OR ARE WE MADE TO? The biggest challenge undoubtedly lies in the political and social acceptance of the policies needed, many of which rely on overly hypothetical concerns on the part of the consumer. These, however, tend to forget the very much underlying hand discreet links between food supply and food culture as such. Whilst the common opinion——and that very much *includes* academia[57]—is for meat consumption increase to be a demand-driven trend that policy makers should 'cope' or 'deal' with, to Marta Rivera-Ferre (425, 2009), 'increased levels of demand are [...] a supply-driven process resulting from a combination of supply increments and cost externalization, which afterwards have effects on both product prices and consumer habits [...] [and] may cause health, environmental and social problems, [ending] up with the disempowerment of both producers and consumers' (425: 90). Many reasons can be thought of to join her, as well as FAO Ugo Pica-Ciamarra and Joachim Otte, in questioning the appropriateness of the 'livestock revolution' expression, coined in 1999 by Delgado et a. (359) and the current agricultural methods used to supply the meat market. It is not at all absurd to claim that diet shifts, rather than a demand-side and freely decided change, are the result of systemic agro-economic evolutions which have mostly been *reported* onto markets. Alternative diets and agricultural methods would benefits consumers as well as producers, including poor producers of the South.[304, 419]

Simple and efficient policy measures—'for starters,' one could say—could include, rather than constraints on the consumer, obligating restaurants to offer a minimum amount of meat-free dishes, as well as the end of subsidies granted to agricultural sectors which aren't of benefit to consumers health, the environment, not, at the end of the day, to producers themselves. 'Our palaeolithically conditioned biological and behavioural regulation of appetite is not attuned to resisting [the temptation of fast-food],' McMichael et a. write (153: 5), but that is taking quite quickly for granted that their overwhelming presence in the streets of most developed and developing countries, as well as the almost total absence of healthier alternatives, has got nothing to do with the issue, which is a very questionable assumption. And were it true, there is little that sound and efficient education and information schemes cannot achieve.

'FAST' AND 'SLOW' FOOD. UNDERSTANDING SUSTAINABILITY AS A SOCIETAL PARADIGM When 'launching' the debate back in 1997, Goodland 120 defined 'environmental sustainability' as '*improving* our lifestyle in order to maintain natural capital' (120: 189–190; our emphasis). And

57. See e.g. 359 or 74.

indeed many reasons can lead to believe that the necessary shift is indeed an improvement rather than a necessary and constraining burden. In the food sector as in any other, avoiding rebound effects means avoiding the pitfall of an overly sectorial action (323). Given the importance of cultural aspects of food consumptions, more should be done to promote, rather than incentives out of the current dietary patterns, truly alternative options including a real cultural and societal content. The Slow Food movement sets such an example, and offers insights into one of many possible alternatives.

TOWARDS A (MORE) 'CARBON-NEUTRAL' INDIVIDUAL? After Vandenbergh & Steinemann's article ('The Carbon-Neutral Individual' [445], 2007), —

NEED FOR FURTHER WORK AND POLICIES As we said introducing the issue of CF, GHGs are one among many environmental problems caused by today's agricultural methods and dietary habits. There is need for further research, both on LCA and on the resulting possible communication and policy measures needed, and there is need to integrate these within the broader frame of environmental responsibility, beyond the urgent issue of climate change. Leach et a. (2010) have already suggested such an approach and prospects for the labelling of nitrogen emissions, and developed an online measuring tool which has gained attention from the European Commission: such efforts must be encouraged, and other sectors should be considered in the future. The broader the information, communication and awareness-raising, the lighter tomorrow's diets and agriculture will be for both human health and the environment.

	Food-miles highs and lows
Beverages	330km delivery, 1 200 km total
Red meat	1 800km delivery, 20 400 total [a]
	Contribution to freight requirement
Cereals/carbohydrates	14%
Red meat	13% [a]
Fruit/vegetables	10%
Non-alcoholic beverages, fats/sweets/condiments, dairy products, non-red meats (including chicken, fish, eggs and nuts) and other miscellaneous processed food products (mostly frozen)	around 6–8% each
	Final delivery as proportion of the whole transport, highs and lows
Red meat	9% [a]
Fruits and vegetables	50%
	Share of transport mode
International water	29%
Truck	28%
Rail	29%
Inland water	10%
Oil and gas pipelines	3%
International air transport	<1%
	Share of GHGs emissions by freight mode [b]
Trucking	71%
Gas pipelines	7%
Rail	6%
Transport of passengers [c]	5%
International water	4%
Inland water	3%
	Food-miles related GHGs per foodstuff
Fruits and vegetables	23%
Final Delivery	39%

Figure 13 – Weber & Matthews' (2008: 3511) food-miles figures (US)

a. *Of which we see the disproportionally important share of supply chains in red meat production.*

b. *To those criticizing the growing internationalization of food chains, the authors note:*

> globalization from 1997 to 2004 increased the average distance moved by food by around 25%, from 1640 km (1020 mi) directly and 6760 km (4200 mi) in total to 2050 km (1250 mi) directly and 8240 km (5120 mi) in total. While this is a remarkable shift in terms of distance, because ocean shipping, which is greater than 99% of total international ocean and air shipping, is far less energy intensive than overland trucking, the total increase in the [GHGs] emissions associated with transport is only 5%, from 0.91 t CO_2/household/yr (0.35 direct) to 0.96 t CO_2/ household/yr (0.36 direct). Thus, even with the large shift in distance traveled due to globalization, the climate impacts of freight supply chains remain dominated by overland truck transport and significantly smaller than the production impacts of food. *(206: 3512.)*

This of course does not integrate other notions, which may not at all be illegitimate in the global debate on international food fairness and sustainability, but that shall be discussed *below (see p. 58)*.

c. *I.e., moving people within the supply chain.*

Figure 14 – Gadema & Oglethorpe (2011: 818), Figure 1:
Average scores on a 4 point Likert scale against the importance of different food attributes, $n = 428$

See also: Fig. 15, 16, 17, 18, 19, 20, 21, 22 & 23

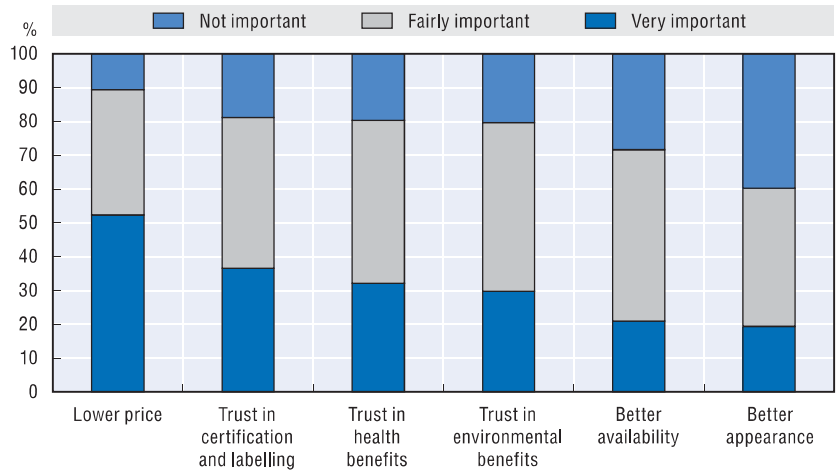


Figure 15 – OECD (2011: 123), Fig. 6.2:
Motivations to consume more organic food products

See also: Fig. 14, 16, 17, 18, 19, 20, 21, 22 & 23

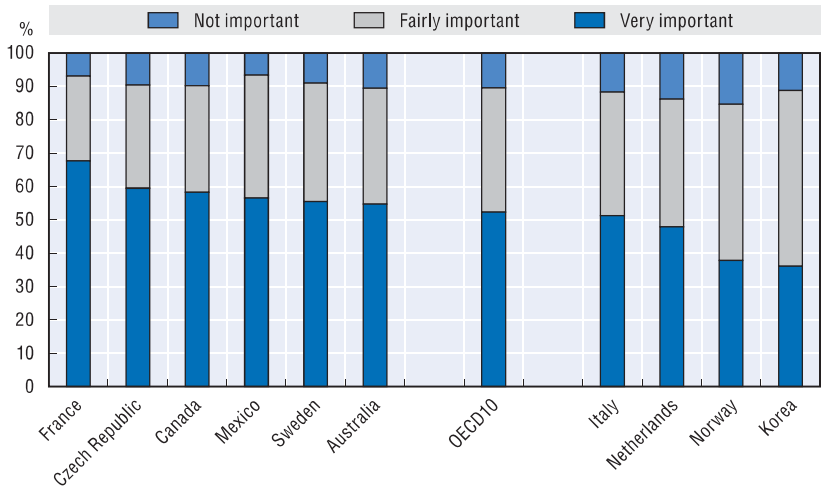
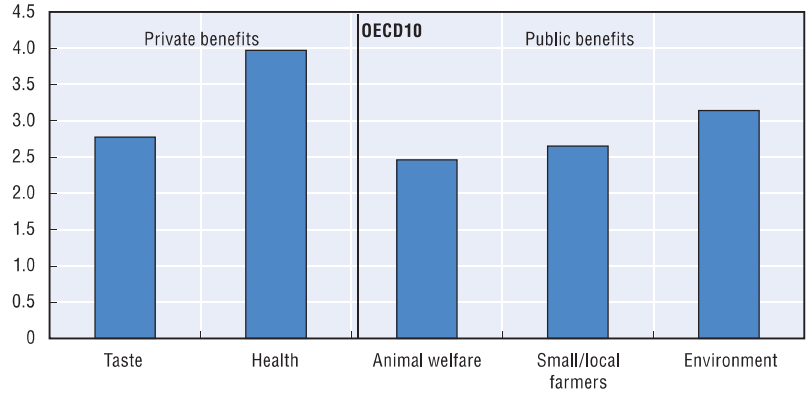


Figure 16 – OECD (2011: 124), Fig. 6.3:
The importance of price in encouraging respondents to consume more organic food, by country

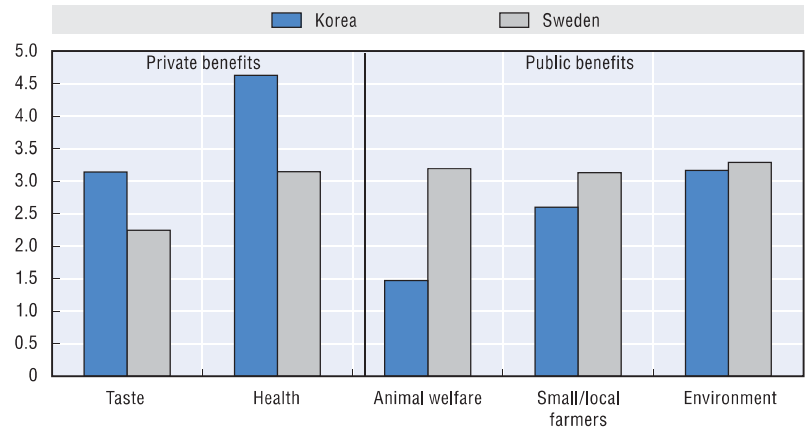
See also: Fig. 14, 15, 17, 18, 19, 20, 21, 22 & 23



Note: The y axis represents the average rank (5 highest, 1 lowest) – this rank question was only for people who consumed organic food.

Figure 17 – OECD (2011: 125), Fig. 6.4:
Public *versus* private motivation to consume organic food, OECD10

See also: Fig. 14, 15, 16, 18, 19, 20, 21, 22 & 23



Note: The y axis represents the average rank (5 highest, 1 lowest) – this rank question was only for people who consumed organic food.

Figure 18 – OECD (2011: 125), Fig. 6.5:
Comparing "public" and "private" motivation to consume organic food in Sweden and Korea

See also: Fig. 14, 15, 16, 17, 19, 20, 21, 22 & 23

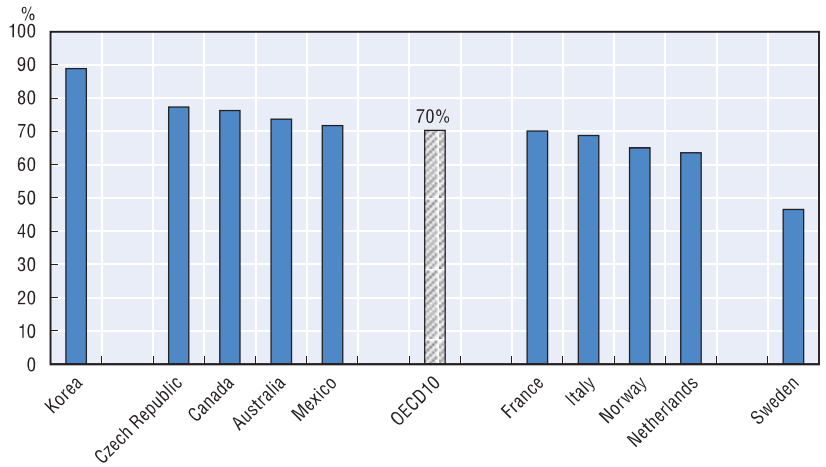


Figure 19 – OECD (2011: 126), Fig. 6.6:
Proportion of households ranking health higher than the environment in their motivation to consume organic food, by country

See also: Fig. 14, 15, 16, 17, 18, 20, 21, 22 & 23

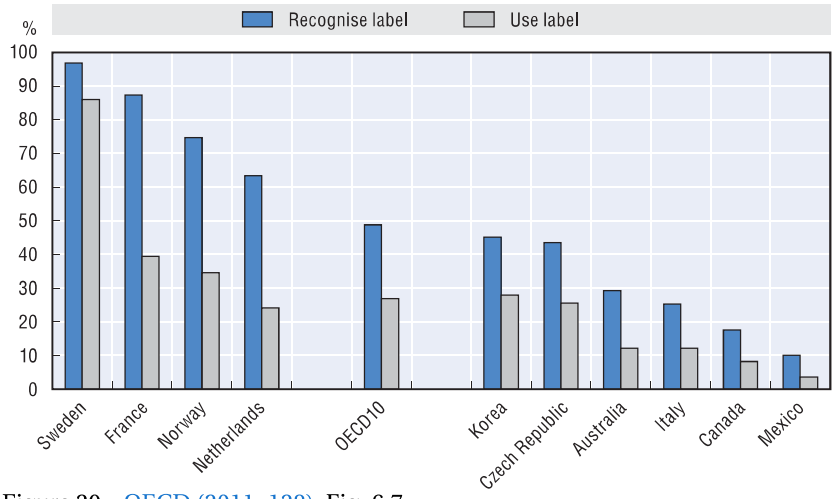


Figure 20 – OECD (2011: 128), Fig. 6.7:
Actual organic food label recognition and use, by country

See also: Fig. 14, 15, 16, 17, 18, 19, 21, 22 & 23

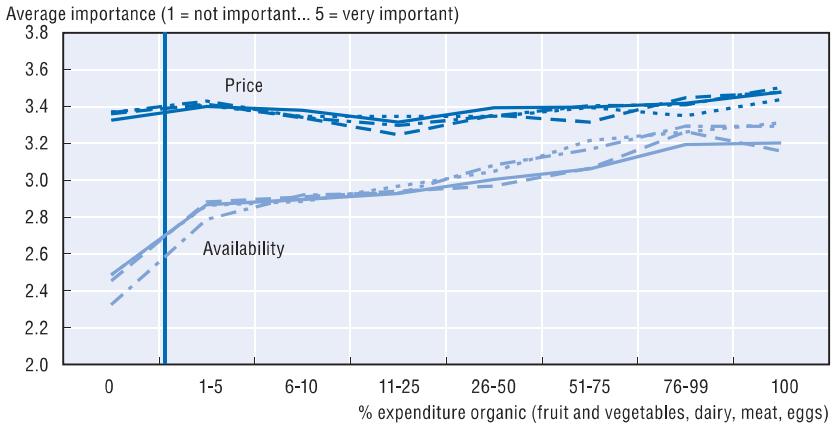
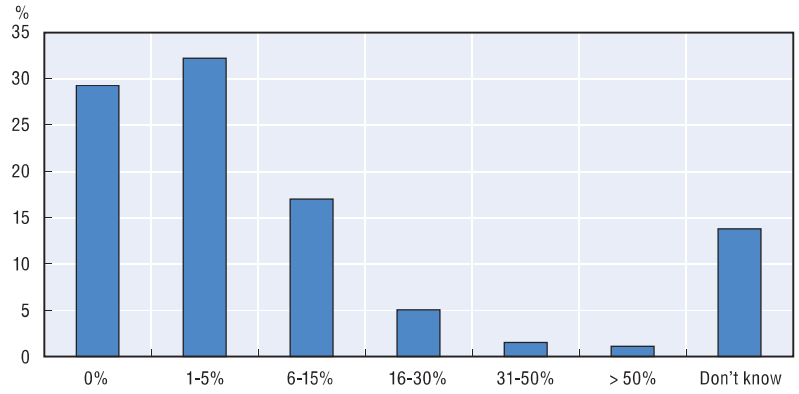


Figure 21 – OECD (2011: 132), Fig. 6.11:
The importance of "better availability" and "lower price" in the motivation to start consuming and to consume more organic food, by groups

See also: Fig. 14, 15, 16, 17, 18, 19, 20, 22 & 23



Note: These percentages have been calculated by taking the mean percentage of the 5 food groups for each willingness-to-pay category.
For example the average is taken of proportion of people for each food group stating they are not willing to pay any premium for organic food (0%) where the result 29% is the average of (28% fruit + vegetables, 29% dairy, 30% eggs, 30% cereal and 29% meat).

Figure 22 – OECD (2011: 133), Fig. 6.12:
Willingness-to-pay (percentage price increase) for organic food, OECD10

See also: Fig. 14, 15, 16, 17, 18, 19, 20, 21, & 23

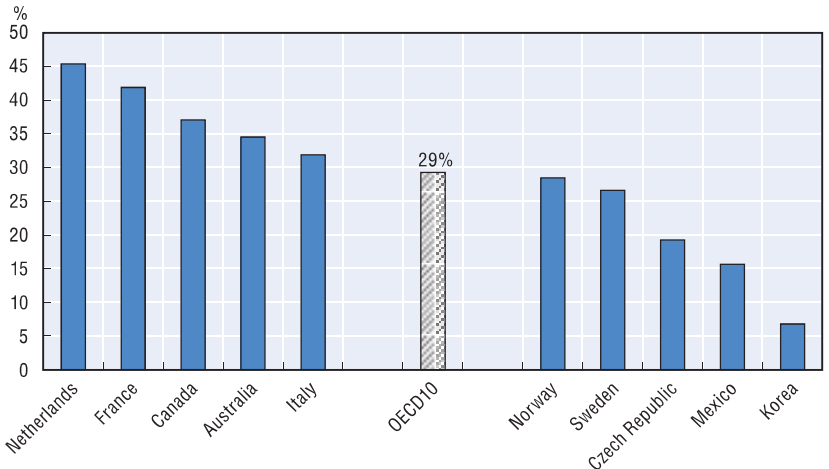


Figure 23 – OECD (2011: 134), Fig. 6.13:
Percentage of respondents not willing to pay any price premium for organic food by country

See also: Fig. 14, 15, 16, 17, 18, 19, 20, 21, & 22

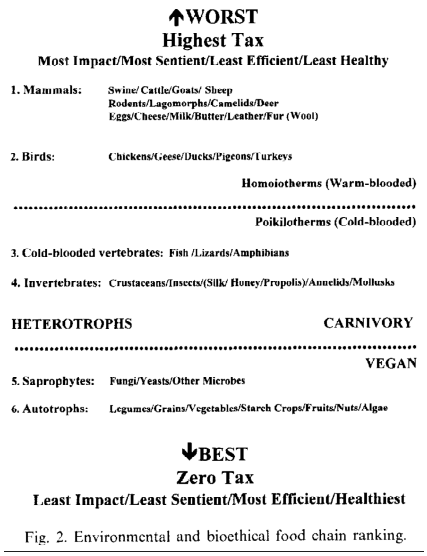


Fig. 2. Environmental and bioethical food chain ranking.

Figure 24 – Goodland (1997: 196), Fig. 2:
Environmental and bioethical food chain ranking (and corresponding tax levels)

Regulation of the individual		**Fiscal measures directed at the individual**		**Non-regulatory and non-fiscal measures with relation to the individual**					
						Choice architecture ("Nudges")			
Interventions category									
		Guide and enable choice							
Eliminate choice	Restrict choice	Fiscal disincentives	Fiscal incentives	Non-fiscal incentives and disincentives	Persuasion	Provision of information	Changes to physical environment	Changes to the default policy	Use of social norms and salience
Examples of policy interventions									
Prohibiting goods or services e.g. banning certain drugs	Restricting the options available to individuals e.g. outlawing smoking in public places	Fiscal policies to make behaviours more costly e.g. taxation on cigarettes or congestion charging in towns and cities	Fiscal policies to make behaviours financially beneficial e.g. tax breaks on the purchase of bicycles or paying individuals to recycle	Policies which reward or penalise certain behaviours e.g. time off work to volunteer	Persuading individuals using argument e.g. GPs persuading people to drink less, counselling services or marketing campaigns	Providing information in e.g. leaflets showing the carbon usage of household appliances	Altering the environment e.g. traffic calming measures or designing buildings with fewer lifts	Changing the default option e.g. requiring people to opt out of rather than opt into organ donation or providing salad as the default side dish	Providing information about what others are doing e.g. information about an individual's energy usage compared to the rest of the street
						Regulation to require businesses to use front of pack nutritional labelling, or restaurants to provide calorific information on menus[a]	*Regulation to require businesses to remove confectionery from checkouts, or the restriction of advertising of unhealthy products*[a]		*Regulation to require energy companies to provide information about average usage*[a]

[a] Demonstrates how regulation of businesses might be used to guide the choice of individuals, thus distinguishing it from regulation, which restricts or eliminates the choice of individual.

Figure 25 – Young & Middlemiss (2012, p. 743), Table 1:
House of Lords behaviour change report's table of interventions (p. 10)

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> Estimates of global [GHGs] emissions attributable to livestock range from 8 to 51%. This variability creates confusion among policy makers and the public as it suggests that there is a lack of consensus among scientists […] In reality, estimates of international scientific organizations such as the [IPCC] and the [FAO] are in close agreement, with variation mainly arising on how [GHGs] emissions are allocated to land use and land use change. Other estimates involve major deviations from international protocols […] Global estimates of livestock [GHGs] emissions are most reliable when they are generated by internationally recognized scientific panels with expertise across a range of disciplines, and with no preconceived bias to particular outcomes. *(Abstract.)*
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Compare to 452
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> The [FAO's] [...] report [187] [...] stated that 18 % [...] of [GHGS] are directly and indirectly related to the world's livestock. The report's statement that livestock production is responsible for a greater proportion of anthropogenic emissions than the entire global transportation sector [...] is frequently quoted in the public press [...] and continues to inform public policy. **Recent estimates** [of the Environmental Protection Agency, USA] [...] **on the impacts of livestock on climate change in the United States and California have arrived at much different GHGs estimates** associated with direct livestock emissions (enteric fermentation and manure), **totaling at less than 3 % of total anthropogenic GHGs and much smaller indirect emissions** compared to the global assessment. Part of the difference of the global versus national predictions is due to the significant weight that has been assigned to the category of 'land-use change' patterns related to livestock production (mainly deforestation). Furthermore, [187] attempts a life cycle assessment for global livestock production but does not use an equally holistic approach for its transportation prediction numbers. The primary focus of the present paper is to examine the relative contributions of livestock to climate change at different geographical and production scales. *(Abstract.)*

> '[168] wrote a comment on [187], that in the media was perceived as fundamental critique. [187] suggests that 18% of anthropogenic global warming caused by livestock production over its life cycle, well in line with our results and others we refer to. [168] rightly points out that this 18% concerns direct and indirect (life cycle) impacts, e.g. including land use change for feed production. This should not be compared to direct emissions of car transport (as apparently was done in [187]) — direct emissions from livestock obviously are lower than those of car transport. The large number of life-cycle based studies quoted by us, however, show unambiguously that when looking at meat and dairy as well as transport from a final consumption perspective, both are among the consumption categories most relevant for global warming. *(Tukker et a. 2011 [198]: 1783, footnote nº 22.)*

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Acronyms

CF . . . . . carbon footprint
CO_2e . . . . . CO_2 equivalent[61]
EF . . . . . ecological footprint
FEFP . . . . . food ecological footprint
GDP . . . . . gross domestic product
GHGs . . . . . green house gases
HANPP . . . . . human appropriation of net primary production
IPCC . . . . . International Panel of Experts on Climate Change
LCA . . . . . life cycle analysis
LUC . . . . . land use change
PCT . . . . . personal carbon trading

61. *See note on p. 4.*