Shifting consumers towards sustainable food consumption and avoiding food waste: Protocol for a machine-learning assisted systematic review and meta-analysis of demand-side interventions

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Abstract

It is now widely accepted that a significant portion of emissions reductions required to meet net zero targets must come from individual behaviour change. Shifting consumers towards more sustainable food consumption and avoiding food waste and loss (FWL) have been identified as two key levers to tackle climate change at the individual and household level. While the IPCC estimates substantial “technical potential” to reduce emissions via changes in diets and reductions in FWL, there is a lack of learning on which climate solutions can best harness this potential. The purpose of this systematic review and meta-analysis is to synthesise the empirical literature reporting on demand-side interventions targeting sustainble food consumption and food waste behaviours of individuals and households. The review encompasses empirical research evaluating a wide range of policy interventions targeted at changing actual food consumption and waste behaviours, which have the potential to contribute towards climate change mitigation. The review forms part of an ‘ecosystem of reviews’, a large-scale evidence synthesis initiative seeking to provide a comprehensive analysis of household-scale interventions and their emissions reduction potential. The reviews within the ecosystem utilise state-of-the-art AI-assisted screening procedures and follow a set of harmonised inclusion criteria.

Introduction

Background

Approximately one third of global greenhouse gas (GHG) emissions are linked to the global food system, making it one of the highest polluting sectors (Crippa et al., 2021). The potential of demand-side strategies for climate change mitigation has recently been highlighted by the UN Intergovernmental Panel on Climate Change (IPCC) sixth Assessment Report (WGIII). The report is the first of its kind to explicitly consider demand-side mitigation potential and provides a convenient framework – *Avoid-Shift-Improve*(ASI) – to categorise mitigation strategies targeted at *avoiding* and *shifting*final service demand, or *improving* service delivery (IPCC, 2022).

Within this context, s*hifting* consumers towards more sustainable food consumption and *avoiding* food waste and loss (FWL) have been identified as two key levers to tackle climate change at the individual and household level (Creutzig et al., 2022; Dubois et al., 2019; Reisch, 2021; Reisch et al., 2021). Moreover, influecing or steering people’s food choices through targeted policy interventions, previously ”off-limits” for policymakers, is increasingly being considered by governments around the world, given the urgent need to curb climate change and biodiversity loss (Stern, 2022). While the IPCC estimates substantial “technical potential” to reduce emissions via changes in diets and reductions in FWL, there is a lack of learning on which climate solutions can best harness this potential. In recent years, there has been a rapid increase in the number of empirical studies exploring demand-side interventions targeting food consumption and FWL behaviours, across multiple disciplines and research fields.

More recently, several attempts have been made to synthesise subsets of this rapidly growing literature, usually focusing on specific behavioural sub-domains or types of intervention. Given the multiple benefits associated with reductions in meat consumption and shifts to plant-based diets, much research has focused on interventions that influence animal-product consumption. Within this sub-domain, recent reviews have concentrated on behavioural interventions (Bianchi et al., 2018; Taufik et al., 2019), consumption-side interventions (Kwasny et al., 2021) and experimental studies (Harguess et al., 2020). This large literature has recently been synthesised in a meta-review (Grundy et al., 2022), which showed that only two of twelve assessed reviews conducted quantitative meta-analyses. Few reviews have considered broader definitions of sustainable dietary shift, or are limited to a behavioural sub-domain within broader meta-analyses on behavioural interventions (Mertens et al., 2022; Nisa et al., 2019).

Similarly, reviews on FWL have focused on behavioural interventions (Barker et al., 2021; Reisch et al., 2021) or utilised rapid review methods to explore consumption-stage interventions for the academic literature published between 2006 and 2017 (Reynolds et al., 2019). Only one recent systematic map has studied both food consumption and food waste behaviours, providing a geographic analysis of where current empirical research is concentrated (Reisch et al., 2021).

While each of the aforementioned studies make important individual contributions, the existing literature falls short of providing a rigorous and holistic assessment of which climate solutions are most effective in tackling climate change via shifts towards more sustainable diets and reductions in FWL by individuals and households. As a result, generalisability and applicability of the emerging empirical findings remains limited. In light of the increasing urgency for emissions reductions, coordinated systematic evidence synthesis and quantification of emissions mitigation potential is urgently needed to inform robust, evidence-based climate solutions around the world.

Objective

The objective of this research is to conduct a machine-learning assisted systematic review and meta-analysis of the empirical literature exploring the behaviour-change potential of demand-side interventions targeting food consumption and food waste behaviours at the individual and household level. We focus on two key areas of behaviour change which hold significant emissions mitigation potential in the food sector: (1) Shifting consumers towards sustainable food consumption and (2) avoiding food waste and loss (Creutzig et al., 2022).

For the purpose of this review, we define shifts to sustainable food consumption as any form of dietary change which has the potential to reduce GHG emissions. This primarily includes dietary shifts which are motivated by climate concerns but may also encompass behaviour change stemming from alternative motives such as improving one's health, animal welfare and limiting biodiversity loss, provided that climate co-benefits can be explicitly identified and quantified. We define avoiding food waste and loss (FWL) as any behaviour change aimed at reducing edible food that is wasted or lost by the consumer at

the end of the supply chain (i.e., in the consumption phase). In addition to providing an average estimate for the effectiveness of demand-side interventions, the meta-analysis will also try to explore the relative effectiveness of different policy instruments and heterogeneity in different contexts, countries, and settings.

This systematic review and meta-analysis will form part of an “ecosystem of reviews”, a set of coordinated systematic reviews exploring the empirical literature exploring the effectiveness and mitigation potential of demand-side interventions to induce household-scale behaviour change, across a range of key polluting sectors (including transport, buildings and manufacturing;). All reviews within the “ecosystem” will follow a set of harmonised decision criteria (see Table 1) which were jointly developed to facilitate inter-review consistency of the screening protocol. The decision criteria align the reviews on key aspects (where applicable), including the research question and inclusion criteria across PICOS domains. Moreover, the reviews will utilise a consistent machine-learning assisted screening procedure developed to efficiently screen and synthesise large volumes of literature. The initiative, led by the Mercator Centre for Climate Change (MCC) in Berlin, will strengthen our understanding of the emissions-mitigation potential of demand-side climate change policies and contribute towards broader evidence synthesis efforts for upcoming IPCC Assessment reports.

Research Question

The primary research question of this study is: How effective are demand-side interventions/policies in shifting individuals/households towards more sustainable food consumption (i.e. diets and food consumption choices which have the potential to reduce GHG emissions) and/or avoiding (i.e. reducing) food waste and loss.

Reagents

Equipment

Procedure

Screening Protocol

Procedure

1.0 Objective

The objective of this protocol pre-registration is to outline a clearly defined screening protocol following best practice guidance on rigorous evidence synthesis (The Campbell Collaboration, 2020) and RepOrting

Standards for Systematic Evidence Syntheses (ROSES). The development of the research question, inclusion and exclusion criteria as well as the search string are guided by the ecosystem of review's harmonised decision criteria (see Figure 1) and further specified using the PICOS framework: population (P), intervention (I), comparator (C), outcome (O) and study type (S).

2.0 Scoping

In the initial scoping phase, the research team jointly identified a subset of 20 articles which were considered relevant, in order to identify and refine appropriate search terms. Articles were selected in line with the harmonised decision criteria and the study specific inclusion and exclusion criteria, informed by the research team's combined experience in conducting applied behavioural research in food policy domains.

2.1 Bibliographic Databases

The search will be conducted on a set of scientific bibliographic databases, including Web of Science, Scopus, MEDLINE and the academic search engine Google Scholar. We will screen the first 1000 results of the search output from Google Scholar.

3.0 Search String

The search string (see Figure 2) was jointly developed by the research team in an iterative process. The final search string consists of four substrings, linked by the Boolean Operator "AND", seeking to incorporate multiple elements of the PICOS criteria. The first substring defines the population. The second substring refers to the outcomes of interest and is subdivided into multiple components, linked by Boolean Operator "OR", for food consumption, dietary change and food waste and loss. The third substring defines the interventions of interest, and the fourth substring specifies the study type. The search string will use field tags to simultaneously search title, abstract and author keywords.

3.1 Languages

The search will be conducted in English, based on an English search string. Relevant non-English papers will be included, based on the languages represented in the research team, if they can be retrieved using the English search string. These include studies published in German, Italian, Portuguese, for which at least two authors in the research teams have sufficient working proficiency.

4.0 Article Screening and Study Inclusion Criteria

The review includes scientific literature from bibliographic databases (see section 2.1) and grey literature from the REPEC (EconPapers) repository, as well as publicly available reports published by specialist organisations and institutions conducting research on food consumption and FWL. REPEC (EconPapers) will be searched using a shortened version of the search string, while websites of specialist organisations

and institutions will be searched manually. The search string is also adapted for searches in Google Scholar (250 characters).

4.1 Screening strategy

The screening strategy combines both conventional elements of a manual screening procedure and novel machine-learning assisted screening.[1]After the initial search is completed, retrieved documents will be uploaded to a customized platform, MCC-APSIS for management and screening. The research team first compiled a training database of relevant studies (see Figure 3) which is subsequently used to develop and iteratively refine a machine learning model which sorts the retrieved literature by predicted relevance. A detailed description of the machine-learning assisted screening procedure employed in this review is provided in van de Schoot et al. (2021) and Callaghan and Müller-Hansen (2020).

Prioritised articles will first be screened at the title and abstract level. Each article will be screened by two independent members of the research team, at this level. Articles which meet all relevant inclusion criteria will subsequently be screened at the full-text level. Screening responsibilities will be split between all members of the research team.

Eligibility of articles/studies will be assessed, in first instance, at the article level. However, if articles report on multiple individual studies, final eligibility decisions will be at the level of the individual study. If several articles report on the same study, these will be grouped together and screened for eligibility as a single unit.

Inter-rater reliability and consistency will be assessed at the title and abstract level using Cohen's Kappa and at the full-text level using Fleiss' Kappa.

4.2 Inclusion & exclusion criteria

To define inclusion and exclusion criteria we follow the well-established PICOS framework (population, intervention, comparator, outcome study type) (The Campbell Collaboration, 2020). Articles written in languages that the authors are proficient in (English, German, Italian, Portuguese), and for which a full text is available will be considered. See Figure 4 for a detailed overview of all inclusion and exclusion criteria.

Population

Included are studies which observe food consumption or FWL behaviours of individuals or households at the individual or aggregate level, in any relevant food choice setting. These may include both real-world settings (supermarkets, restaurants, cafeterias) or (online) experimental settings.

Excluded are studies which observe food consumption or waste behaviours of organizations, institutions or other private or public actors which are not individuals or households.

Intervention

This study takes a broad approach. Included are studies that examine at least one of the following interventions targeted at changing behaviour: (1) Monetary interventions, (2) Informational and/or educational interventions, (3) behavioural interventions, (4) command-and-control regulation. These interventions can be initiated by public, private or public-private actors. Interventions can be targeted at achieving any policy objective (e.g. reducing emissions, improving public health), provided that potential climate benefits or co-benefits can be separated and quantified, in line with the “shift” and “avoid” conceptualisation discussed above. If multiple interventions are tested within the same study, these are assessed separately. If multiple interventions are tested in combination (and their effects cannot be separated), these will be coded as such (e.g., tax + labelling). If the study has a multi-phase intervention design, each phase/intervention is assessed relative to the baseline phase.

Excluded are studies that evaluate interventions that do not fall within the four categories of interventions, or studies that do not evaluate any intervention/policy.

Comparator

Included are studies that have a valid comparison group as a benchmark to which the effectiveness of the treatment intervention can be compared. This includes randomly assigned control groups in experimental studies, or statistically constructed or selected control groups in quasi-experimental studies. In pre-post (time-series) designs, the level of behaviour prior to intervention is considered a valid comparison group.

Excluded are studies that do not have a valid comparison group. Experimental studies where treatment is compared to another treatment group (i.e., no control group is available), will also be excluded.

Outcome

Included are studies that measure actual behaviour or incentive-compatible choices provided that their outcomes entail potential emissions reductions and can be categorised as “shifting” consumers towards sustainable food consumption or “avoiding” food waste and loss. Outcomes are incentive-compatible if they provide an incentive for individuals or households to truthfully reveal their choice or level of behaviour. For instance, a food choice in an experimental online store is considered incentive-compatible if the subject subsequently receives, or has a probability of receiving, the chosen alternative.

Excluded are studies that measure purely hypothetical or non-incentive-compatible choices or any other outcome unrelated to ‘shifting’ food consumption or ‘avoiding’ food waste. Excluded are studies which do not allow climate benefits to be assessed.

Study Type

Included are studies that make use of an experimental design with treatment and comparison groups, utilise quasi-experimental methods or pre-post intervention designs.

Excluded are descriptive, conceptual, theoretical and qualitative studies, as well as stated preference studies (e.g. choice experiments), simulation and other modelling studies.

5.0 Coding of meta-data

The coding protocol will be jointly developed by the research team prior to full-text screening.

6.0 Critical Appraisal

To assess the overall confidence in evidence, all studies that meet the inclusion criteria outlined above will undergo a critical appraisal of study quality using a procedure adapted from common approaches outlined in Sterne et al. (2016; 2019).

[1] https://zenodo.org/record/4121526

Troubleshooting

Time Taken

Anticipated Results

References

Barker, H., Shaw, P. J., Richards, B., Clegg, Z., & Smith, D. (2021). What nudge techniques work for food waste behaviour change at the consumer level? A systematic review. *Sustainability (Switzerland)*, *13*(19), 1–18. https://doi.org/10.3390/su131911099

Bianchi, F., Garnett, E., Dorsel, C., Aveyard, P., & Jebb, S. A. (2018). Restructuring physical micro-environments to reduce the demand for meat: a systematic review and qualitative comparative analysis. *The Lancet Planetary Health*, *2*(9). https://doi.org/10.1016/S2542-5196(18)30188-8

Callaghan, M. W., & Müller-Hansen, F. (2020). Statistical stopping criteria for automated screening in systematic reviews. *Systematic Reviews*, *9*(1), 1–14. https://doi.org/10.1186/s13643-020-01521-4

Creutzig, F., Niamir, L., Bai, X., Callaghan, M., Cullen, J., Díaz-José, J., Figueroa, M., Grubler, A., Lamb, W. F., Leip, A., Masanet, E., Mata, É., Mattauch, L., Minx, J. C., Mirasgedis, S., Mulugetta, Y., Nugroho, S. B., Pathak, M., Perkins, P., … Ürge-Vorsatz, D. (2022). Demand-side solutions to climate change mitigation consistent with high levels of well-being. *Nature Climate Change*, *12*(1), 36–46. https://doi.org/10.1038/s41558-021-01219-y

Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F. N., & Leip, A. (2021). Food systems are responsible for a third of global anthropogenic GHG emissions. *Nature Food*, *2*(3), 198–209. https://doi.org/10.1038/s43016-021-00225-9

Dubois, G., Sovacool, B., Aall, C., Nilsson, M., Barbier, C., Herrmann, A., Bruyère, S., Andersson, C., Skold, B., Nadaud, F., Dorner, F., Moberg, K. R., Ceron, J. P., Fischer, H., Amelung, D., Baltruszewicz, M., Fischer, J., Benevise, F., Louis, V. R., & Sauerborn, R. (2019). It starts at home? Climate policies targeting household consumption and behavioral decisions are key to low-carbon futures. *Energy Research and Social Science*, *52*(September 2018), 144–158. https://doi.org/10.1016/j.erss.2019.02.001

Grundy, E. A. C., Slattery, P., Saeri, A. K., Watkins, K., Houlden, T., Farr, N., Askin, H., Lee, J., Mintoft-Jones, A., Cyna, S., Dziegielewski, A., Gelber, R., Rowe, A., Mathur, M. B., Timmons, S., Zhao, K., Wilks, M., Peacock, J. R., Harris, J., … Zorker, M. (2022). Interventions that influence animal-product consumption: A meta-review. *Future Foods*, *5*, 100111. https://doi.org/10.1016/j.fufo.2021.100111

Harguess, J. M., Crespo, N. C., & Hong, M. Y. (2020). Strategies to reduce meat consumption: A systematic literature review of experimental studies. *Appetite*, *144*(September 2019), 104478. https://doi.org/10.1016/j.appet.2019.104478

Kwasny, T., Dobernig, K., & Riefler, P. (2021). Towards reduced meat consumption: A systematic literature review of intervention effectiveness, 2001–2019. *Appetite*, *168*(August 2020), 105739. https://doi.org/10.1016/j.appet.2021.105739

Mertens, S., Herberz, M., Hahnel, U. J. J., & Brosch, T. (2022). The effectiveness of nudging: A meta-analysis of choice architecture interventions across behavioral domains. *Proceedings of the National Academy of Sciences of the United States of America*, *119*(1). https://doi.org/10.1073/pnas.2107346118

Nisa, C. F., Bélanger, J. J., Schumpe, B. M., & Faller, D. G. (2019). Meta-analysis of randomised controlled trials testing behavioural interventions to promote household action on climate change. *Nature Communications*, *10*(1). https://doi.org/10.1038/s41467-019-12457-2

Reisch, L. A. (2021). Shaping healthy and sustainable food systems with behavioural food policy. *European Review of Agricultural Economics*, *00*(00), 1–29. https://doi.org/10.1093/erae/jbab024

Reisch, L. A., Sunstein, C. R., Andor, M. A., Doebbe, F. C., Meier, J., & Haddaway, N. R. (2021). Mitigating climate change via food consumption and food waste: A systematic map of behavioral interventions. *Journal of Cleaner Production*, *279*, 123717. https://doi.org/10.1016/j.jclepro.2020.123717

Reynolds, C., Goucher, L., Quested, T., Bromley, S., Gillick, S., Wells, V. K., Evans, D., Koh, L., Carlsson Kanyama, A., Katzeff, C., Svenfelt, Å., & Jackson, P. (2019). Review: Consumption-stage food waste reduction interventions – What works and how to design better interventions. *Food Policy*, *83*(December 2018), 7–27. https://doi.org/10.1016/j.foodpol.2019.01.009

Stern, N. (2022). A Time for Action on Climate Change and a Time for Change in Economics. *The Economic Journal*, *132*(644), 1259–1289. https://doi.org/10.1093/ej/ueac005

Sterne, J. A. C., Savović, J., Page, M. J., Elbers, R. G., Blencowe, N. S., Boutron, I., Cates, C. J., Cheng, H. Y., Corbett, M. S., Eldridge, S. M., Emberson, J. R., Hernán, M. A., Hopewell, S., Hróbjartsson, A., Junqueira, D. R., Jüni, P., Kirkham, J. J., Lasserson, T., Li, T., … Higgins, J. P. T. (2019). RoB 2: A revised tool for assessing risk of bias in randomised trials. *The BMJ*, *366*, 1–8. https://doi.org/10.1136/bmj.l4898

Sterne, J. A., Hernán, M. A., Reeves, B. C., Savović, J., Berkman, N. D., Viswanathan, M., Henry, D., Altman, D. G., Ansari, M. T., Boutron, I., Carpenter, J. R., Chan, A. W., Churchill, R., Deeks, J. J., Hróbjartsson, A., Kirkham, J., Jüni, P., Loke, Y. K., Pigott, T. D., … Higgins, J. P. (2016). ROBINS-I: A tool for assessing risk of bias in non-randomised studies of interventions. *BMJ (Online)*, *355*, 4–10. https://doi.org/10.1136/bmj.i4919

Taufik, D., Verain, M. C. D., Bouwman, E. P., & Reinders, M. J. (2019). Determinants of real-life behavioural interventions to stimulate more plant-based and less animal-based diets: A systematic review. *Trends in Food Science and Technology*, *93*(September), 281–303. https://doi.org/10.1016/j.tifs.2019.09.019

The Campbell Collaboration. (2020). *Campbell systematic reviews: Policies and guidelines*. *December*, 1–48.

van de Schoot, R., de Bruin, J., Schram, R., Zahedi, P., de Boer, J., Weijdema, F., Kramer, B., Huijts, M., Hoogerwerf, M., Ferdinands, G., Harkema, A., Willemsen, J., Ma, Y., Fang, Q., Hindriks, S., Tummers, L., & Oberski, D. L. (2021). An open source machine learning framework for efficient and transparent systematic reviews. *Nature Machine Intelligence*, *3*(February), 125–133. https://doi.org/10.1038/s42256-020-00287-7

Figures

	Dimension	Decision Criteria
1.	Research Question	Does the paper study the *effectiveness* of an *intervention or policy* targeted at *changing behaviour* at the *individual or household level* which has *emissions mitigation potential*?
2.	Population	Does the paper study behaviour change at the *household or individual* level? The papers should look at individual/ household decision making and interventions that influence them. Where these decisions are measured at a higher observational level (canteen, dormitories, etc.) these can also be included.
3.	Intervention	Does the paper study an *intervention* or *policy* targeting behaviour change? This can be any intervention that falls into to one of the following categories: (1) monetary interventions, (2) information and/or educational interventions, (3) behavioural interventions, (4) command-and-control regulation
4.	Comparator	Does the paper use a study design which has a valid comparison group as a benchmark to quantify behaviour change? This can be a control group in experimental studies, a statistically constructed or selected control group in quasi-experimental studies or the level of behaviour before the intervention in longitudinal designs. This excludes any studies that does not observe behaviour in a control group or compares behaviour in one treatment group to another treatment group.
5.	Outcome	Does the paper study actual behaviour change or incentive-compatible choices that are related to climate change (explicitly or implicitly) and hold emissions mitigation potential? This includes choices that are made in an artificial setting (e.g., an online experiment), as long as these choices are consequential for the individual or household. This excludes any outcomes which are purely hypothetical or non-consequential.
6.	Study type	Does the paper report on analyses of empirical data that employ experimental, quasi-experimental or longitudinal designs? This can include any design which either utilises randomisation or quasi-experimental methods to establish a valid counterfactual and estimate causal effects, or a pre-post design which utilises longitudinal data.

Figure 1

Summary of harmonised decision criteria

		Search Keywords
Population	*Population & Settings*	**TS=**(((household* OR individual OR consumer* OR customer* OR participant* OR caf* OR restaurant* OR takeaway* OR canteen* OR catering OR supermarket* OR store* OR school* OR workplace* OR shop OR festival OR event OR menu* OR "food setting" OR "food environment"))
Outcome	*Food consumption & Food waste and loss*	**AND** (((food OR meal OR basket OR meat* OR beef OR lamb OR seafood OR fish OR dairy OR milk OR "local food" OR "meat alternative" OR "meat substitute" OR "synthetic meat" OR "alternative protein" OR "cultured meat") NEAR/2 (consum* OR purchas* OR choos* OR choice* OR behav* OR shop* OR select* OR prefer* OR decision OR intak* OR habit* OR demand* OR buy* OR avoid* OR eat* OR cook* OR diet* OR reduc* OR shift* OR chang* OR increas* OR decreas* OR susbtitut*)) OR (("plant-based" OR "meat-free" OR vegetarian* OR vegan* OR flexitarian* OR climat* OR sustainab* OR environment* OR pescatarian) NEAR/2 (diet* OR food* OR eat* OR meal OR menu OR choice*)) OR "diet* change" OR "diet* shift" OR (food NEAR/2 (wast* OR loss OR scrap* OR recycl* OR dispos* OR carbon* OR compost* OR uneaten)))
Intervention	*Monetary interventions, behavioural interventions, information and education provision, command and control measures.*	**AND** (((behavio$r* OR "demand-side" OR monetary OR economic OR financial) NEAR/2 (intervention* OR incentiv* OR polic* OR change* OR stimul* OR guideline* OR measur*)) OR intervention OR incentiv* OR pric* OR tax* OR subsid* OR permit* OR rebate* OR reward* OR voucher* OR coupon* OR discount* OR stimulus OR audit OR ((information*) NEAR/3 (campaign* OR provi* OR strateg* OR acquisition OR system*)) OR feedback OR educat* OR label* OR "eco-score" OR nudg* OR "choice architecture" OR norm OR "normative" OR "social influence" OR "social comparison*" OR "social learning" OR "peer comparison*" OR salience OR "positioning" OR ((chang* OR alter*) NEAR/3 order*) OR "goal setting" OR "commitment device*" OR pledge OR default* OR rule* OR regulation* OR law* OR legislat* OR standard OR directive OR ban OR certifi* OR prescrib* OR prescription* OR guidance OR guideline* OR "plate-size" OR "serving-size" OR ration* OR prohibit*)
Study Type	*Experimental and quasi-experimental settings, random assignment.*	**AND** (RCT OR experiment* OR "field study" OR trial* OR "treatment group" OR "control group" OR "control condition" OR "treatment condition" OR "pre-post" OR "post-test" OR "before-after" OR "randomi?ed" OR "random* assign*" OR "intervention study" OR "causal*" OR "manipulation" OR "within-subject" OR "within-participant" OR "time-series" OR "panel" OR "impact assessment" OR "impact evaluation" OR "difference$-in-difference*" OR "instrumental variable" OR "synthetic-control" OR "fixed-effect*" OR "matching" OR "regression discontinuity" OR counterfactual))

Figure 2

Full Boolean Search String

	Shift to sustainable food consumption (including health domain)
1.	Lohmann, P. M., Gsottbauer, E., Doherty, A., & Kontoleon, A. (2022). Do carbon footprint labels promote climatarian diets? Evidence from a large-scale field experiment. Journal of Environmental Economics and Management, 114, 102693.
2.	Kurz, V. (2018). Nudging to reduce meat consumption: Immediate and persistent effects of an intervention at a university. *Journal of Environmental Economics and Management*, *90*, 317–341.
3.	Garnett, E. E., Balmford, A., Marteau, T. M., Pilling, M. A., & Sandbrook, C. (2021). Price of change: Does a small alteration to the price of meat and vegetarian options affect their sales? *Journal of Environmental Psychology*, *75*(May 2020).
4.	Garnett, E. E., Balmford, A., Sandbrook, C., Pilling, M. A., & Marteau, T. M. (2019). Impact of increasing vegetarian availability on meal selection and sales in cafeterias. Proceedings of the National Academy of Sciences of the United States of America, 116(42), 20923–20929.
5.	Panzone, L. A., Ulph, A., Hilton, D., Gortemaker, I., & Tajudeen, I. A. (2021). Sustainable by Design: Choice Architecture and the Carbon Footprint of Grocery Shopping. *Journal of Public Policy & Marketing*, *40*(4), 463–486.
6.	Jalil, A. J., Tasoff, J., & Bustamante, A. V. (2020). Eating to save the planet: Evidence from a randomized controlled trial using individual-level food purchase data. *Food Policy*, *95*, 101950.
7.	Velema, E., Vyth, E. L., Hoekstra, T., & Steenhuis, I. H. (2018). Nudging and social marketing techniques encourage employees to make healthier food choices: a randomized controlled trial in 30 worksite cafeterias in The Netherlands. The American journal of clinical nutrition, 107(2), 236-246.
8.	Richter, Isabel, John Thøgersen, and Christian A. Klöckner. 2018. "A Social Norms Intervention Going Wrong: Boomerang Effects from Descriptive Norms Information" *Sustainability* 10, no. 8: 2848.
9.	Taufik, D., Bouwman, E. P., Reinders, M. J., & Dagevos, H. (2022). A reversal of defaults: Implementing a menu-based default nudge to promote out-of-home consumer adoption of plant-based meat alternatives. Appetite, 175, 106049.
10.	Rosenfeld, D. L., Bartolotto, C., & Tomiyama, A. J. (2022). Promoting plant-based food choices: Findings from a field experiment with over 150,000 consumer decisions. Journal of Environmental Psychology, 101825.
	Avoid food waste and loss
1.	Linder, N., Lindahl, T., & Borgström, S. (2018). Using behavioural insights to promote food waste recycling in urban households—Evidence from a longitudinal field experiment. *Frontiers in psychology*, *9*, 352.
2.	Giaccherini, M., Gilli, M., Mancinelli, S., & Zoli, M. (2021). Nudging food waste decisions at restaurants. *European Economic Review*, *135*, 103722.
3.	Kallbekken, S., & Sælen, H. (2013). 'Nudging' hotel guests to reduce food waste as a win–win environmental measure. *Economics Letters*, *119*(3), 325-327.
4.	Jagau, H. L., & Vyrastekova, J. (2017). Behavioral approach to food waste: an experiment. *British Food Journal*.
5.	Nomura, H., John, P. C., & Cotterill, S. (2011). The use of feedback to enhance environmental outcomes: A randomised controlled trial of a food waste scheme. *Local Environment*, 16(7), 637-653.
6.	Collart, A. J., & Interis, M. G. (2018). Consumer imperfect information in the market for expired and nearly expired foods and implications for reducing food waste. Sustainability, 10(11), 3835.
7.	Li, C., Wang, Y., Li, Y., Huang, Y., & Harder, M. K. (2021). The incentives may not be the incentive: A field experiment in recycling of residential food waste. *Resources, Conservation and Recycling*, *168*, 105316.
8.	Aschemann-Witzel, J., Giménez, A., & Ares, G. (2018). Consumer in-store choice of suboptimal food to avoid food waste: The role of food category, communication and perception of quality dimensions. *Food Quality and Preference*, *68*, 29-39.
9.	Qi, D., & Roe, B. E. (2017). Foodservice composting crowds out consumer food waste reduction behavior in a dining experiment.
10.	van Herpen, E., De Hooge, I. E., de Visser-Amundson, A., & Kleijnen, M. P. (2021). Take it or leave it: How an opt-out strategy for doggy bags affects consumer food waste behavior and restaurant evaluations. Journal of Cleaner Production, 325, 129199.

Figure 3

Publications used to develop keywords for search strings

	Population	Intervention	Comparator	Outcome	Study Type
Inclusion	Individuals, private households, large households (e.g., cafeterias in which individuals make choices)	"Behaviour change interventions" targeted at sustainable consumption, planetary health and food waste reduction: (1) Market-based (monetary) interventions (2) Behavioural interventions (3) Informational interventions (4) Educational interventions (5) Command and control regulation	Individuals, households, large households: (1) that did not receive an intervention, (2) that received a different intervention (evaluated case-by-case), (3) level of "behaviour" before the intervention	Actual behaviour or incentive-compatible choices that can be classified as: (1) "shifting" consumers towards sustainable food consumption or (2) "avoiding" food waste and loss	Empirical quantitative Studies: (1) Experimental design (2) Quasi-experimental (3) Pre-post design
Exclusion	Organizations, business-to-business.	Studies that evaluate an intervention which cannot be classified. Studies that do not evaluate an intervention.	Studies without comparator: (1) No comparison group, (2) No comparison baseline value for outcome.	Hypothetical behaviour, non-incentive compatible choices or self-reported behaviour: (1) Hypothetical food consumption or choices (2) behavioural intentions, (3) willingness to change food consumption, (4) willingness to pay (5) consumer attitudes, values and/or beliefs (6) other stated preferences or non-consequential choices (7) Food waste in production and/or supply-chain (8) Recycling behaviour	(1) Descriptive studies (2) Conceptual studies (3) Theoretical studies (4) Qualitative studies (5) Stated preference studies, (6) Simulation, modelling or predictive studies.

Figure 4

PICOS framework summary of inclusion and exclusion criteria