"粮食产业链数字化和创新技术研究"特约专栏文章之一

预防家庭食物浪费的全球研究视角（中英文）

Christiam MÉNDEZ-LAZARTE[1], Victor BOHORQUEZ-LOPEZ[2],
Ammer GHOULEH-GRUNDL[1], María Ángeles RAMÓN-JERÓNIMO[3]

（1. 利马大学，秘鲁 利马 15082；
2. 天主教大学，多米尼加共和国 圣地亚哥 51000；
3. 巴勃罗·德·奥拉维德大学，西班牙 塞维利亚 41013）

摘　要：食物浪费仍是紧迫的全球性挑战，家庭作为主要的食物浪费源头，了解其关键驱动因素对于促进可持续消费实践至关重要。本研究采用文献计量分析方法，通过共现和共引网络分析，系统梳理了家庭食物浪费预防领域的研究发展脉络。研究发现，该领域已形成三大主要研究集群：（1）食物生态系统视角；（2）供应链管理与衡量机制；（3）扩展的计划行为理论（TPB）及其在影响家庭食物浪费的心理社会因素方面的补充理论。研究结果表明，学术研究重点已从传统的废物管理转向预防性策略，强调政策干预、行为助推和消费者意识提升。本研究通过构建食物浪费研究的知识图谱，识别关键研究空白，为未来更有效的家庭食物浪费预防研究提供了方向，也将为政策制定者、研究人员和从业者在减少家庭食物浪费方面提供理论支持和实践指导。

关键词：文献计量分析；食物浪费预防；家庭食物浪费；消费者行为；可持续发展；食物政策；全球研究视角

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Global Research Perspective on Household Food Waste Prevention (Chinese and English versions)

Christiam MÉNDEZ-LAZARTE[1], Victor BOHORQUEZ-LOPEZ[2],
Ammer GHOULEH-GRUNDL[1], María Ángeles RAMÓN-JERÓNIMO[3]

(1. Universidad de Lima, Lima, Peru 15082; 2. Pontificia Universidad Católica Madre y Maestra, Santiago, Dominican Republic 51000; 3. Universidad Pablo de Olavide, Seville, Spain 41013)

Abstract: Food waste remains a pressing global challenge, with households as major contributors. Understanding its key drivers is essential for fostering sustainable consumption practices. This study employs

a bibliometric analysis, using co-occurrence and co-citation networks, to map the evolution of research on household food waste prevention, identifying key themes and influential works. The co-citation analysis reveals three major research clusters: (1) food ecosystems, (2) supply chains and measurement, (3) the expanded Theory of Planned Behavior and complements in explaining the psycho-social factors influencing household food waste. Findings indicate a shift in research focus from waste management toward prevention, emphasizing policy interventions, behavioral nudges, and consumer awareness. This study contributes to the sustainability discourse by identifying critical research gaps and future directions for more effective food waste prevention. Through mapping the intellectual landscape of food waste research, this work offers valuable insights for policymakers, researchers, and practitioners seeking to minimize household food waste.

Key words: bibliometric analysis; food waste prevention; household waste; consumer behavior; sustainability; food policy; global research perspective

食物浪费是一项紧迫的全球性问题，全球供应链每年约有 13 亿吨食物被丢弃[1]。根据联合国粮食及农业组织（Food and agriculture organization of the United Nations，FAO）的统计数据显示，为人类消费而生产的食物中，近 1/3 在生产、运输和消费过程中被损耗或浪费[2]。这一现象不仅加剧了粮食不安全问题，还对环境造成了巨大压力，并导致经济资源的巨大浪费。食物浪费问题在家庭消费端尤为突出，家庭层面的浪费在食物浪费总量中占比很大[3]。由于食物浪费问题的严重性，减少其浪费已成为全球各国政府、政策制定者和研究人员的首要任务[3-4]。

减少食物浪费的努力 不仅关乎伦理和经济考量，更具有深远的环境意义。食物浪费会导致温室气体排放、过度消耗淡水资源和土地退化，从而加剧了对自然资源的压力，而这些浪费原本是可避免的[1,3]。企业与政策制定者通过采取有效措施解决这些问题，减少供应链中的损失并优化资源分配，从而推动可持续发展并提升经济效率[5-6]。因此，在整个食品系统中实施有效的干预措施，对于实现可持续发展目标具有重要意义[4]。

减少食物浪费与全球可持续发展目标直接相关，联合国可持续发展目标（United Nations sustainable development goals，SDG）12.3 旨在到 2030 年将全球人均食物浪费减半[7]。这需要综合的政策措施，且要从整合环境、经济和社会等多方面视角考虑[3]。

食物浪费的生态足迹贯穿整个食物供应链，从生产到处理的各个环节均会产生显著影响[8]。过度的食物需求推动农业扩张，导致大规模森林砍伐和土壤肥力下降，而食物运输和储存过程进一步加剧了碳排放[9]。当食物被丢入垃圾填埋场后会产生甲烷，这种温室气体的全球变暖潜能值是二氧化碳的 28 倍，对气候变化的加剧作用不容忽视[10]。因此，减轻食物浪费带来的环境影响需要政策制定者、企业和消费者群体的协同合作，通过系统性变革和行为模式的调整，共同推动可持续消费习惯的养成[3]。

为应对日益严峻的食物浪费挑战，全球范围内已采取多种预防和回收措施，包括提升公众意识的宣传活动、食物再分配计划以及完善监管框架[11]。根据亚太经济合作组织（Asia-Pacific economic cooperation，APEC）的研究，各经济体无论发展水平如何，在食物损失和浪费（Food loss and waste，FLW）的规划、领导和治理方面均取得了一定进展[12]。然而，大多数经济体仍面临数据收集系统不完善的问题。尽管建立了相应的治理结构，但仅有少数经济体制定了明确的 FLW 减少目标[12]。值得注意的是，政策工具的制定和实施存在差异，发达经济体已建立明确的政策框架，而发展中经济体仍在探索适合自身国情的治理机制[12]。多层次干预措施在减少食物浪费方面具有显著有效性，这在推动可持续发展进程中发挥着关键作用[4]。

了解食物浪费的动态对于推进可持续性和消费行为的研究很有必要[11]。由于家庭在食物浪费

中占比很大，研究人员需要进一步开展研究，探索行为驱动因素并评估干预策略的有效性[11,13]。对这些模式的研究将有助于制定基于实证的政策，促进可持续的消费和生产实践[4]。因此，在社会多个层面持续努力来促进减少食物浪费至关重要。

本研究采用文献计量分析与文献综述相结合，系统识别家庭食物浪费产生与预防相关的关键词，以期更新研究认知并把握最新研究趋势。在此基础上，梳理家庭食物浪费的成因机制与预防策略，深入探究相关文献间的知识关联，进而识别各类研究方法的理论基础文献。同时，聚焦追踪重要文献的发展脉络与核心主题演进，通过聚类分析代表性研究视角，全面分类与解读塑造该领域的理论框架与方法体系，最终勾勒出该研究领域的发展轨迹与未来方向。

1　定义搜索词

食物损失和食物浪费是两个不同但相关的概念。根据联合国环境规划署[3]的定义，食物损失主要发生在食物供应链前端，通常由于收获、储存、运输等过程效率低而导致。而食物浪费则发生在供应链后端，指消费者或食品服务提供者因外观、质量等丢弃食物不可食用部分的行为。

相比之下，食物浪费现象主要集中在零售环节及消费者行为层面，具体表现为过量采购、膳食规划不当以及对食品保质期标识的误读[14-15]。鉴于家庭层面产生的食物浪费在全球范围内占比高达 53%，研究重点越来越强调"解决食物浪费而非食物损失"问题的重要性，以期实现环境效益与经济效益的双重提升[16]。

食物浪费可分为可避免和不可避免两类[17]。其中，可避免的食物浪费主要表现为因变质、过度采购或管理不当而丢弃的可食用食物，例如剩饭剩菜和过期商品[16-17]。不可避免的食物浪费通常由食物加工过程中产生的不可食用部分构成，如骨头、蛋壳和果皮等[17]。尽管消费者无法完全消除不可避免的浪费，但通过改进日常行为可有效减少可避免的食物浪费，从而显著降低其对环境的负面影响[3]。

本研究的核心区别在于预防与回收策略的对比：预防措施主要通过优化购买和储存习惯来减少浪费的产生，而回收则侧重于通过堆肥或能源回收等方式实现废弃物的再利用。尽管已有研究表明预防措施在减少总体食物浪费方面更具潜力，但许多人仍着重于回收而非预防。鉴于食物浪费行为的复杂性，研究人员通过聚焦消费者态度、经济约束和政策干预等特定因素来界定研究范围。在食物浪费研究领域，运用共现分析方法探讨关键词之间的关联性，不仅有助于识别研究空白和关键主题，还能更好地把握新兴趋势和减少浪费工作的重点[3]。

基于这一背景，本研究采纳联合国环境规划署的观点，将"预防"定义为减少家庭食物浪费的实践[3]。明确界定这一研究领域，对于理解相关各项研究之间的内在联系十分重要。为明确表征这些概念的关键词，首先将对与食物浪费及家庭相关的文献进行关键词共现分析。

2　研究方法

本研究构建了一个结构化的两阶段分析方法，对食物浪费领域的科学文献进行全面梳理。该方法通过优化对相关研究的筛选，对关键研究主题进行针对性考察。采用文献计量分析方法，基于 Web of Science 数据库检索获取的文献数据，对学术出版物进行严格评估。同时，运用文献计量技术分析研究间的关系，深入探究研究趋势和知识结构特征。这一方法框架为理解食物浪费领域的学术论述提供了理论参考。

在第一阶段，使用 Web of Science 核心合集（包含科学引文索引扩展版 SCI-EXPANDED）进行初步检索。检索词为："Food waste AND (Household OR Behavior OR Behaviour)"，文献出版时间范围限定为 2003—2024 年（于 2025 年 2 月 28 日检索）。文献类型限定为期刊文章，初步检索得到 2 210 篇文章。随后，应用筛选条件将结果限制在环境科学类别，并仅选择以英文发表的文章，最终得到 1 126 篇文章的数据集。

在第二阶段，进一步将纳入标准细化为与 "food waste and generation and （behavior OR

household behavior OR household）"相关的文章。此外，应用了排除标准：anaerobic digestion、anaerobic-digestion、life cycle assessment 和 life-cycle assessment。经筛选后，最终数据集包含 226 篇文章。我们系统梳理了以往食物浪费领域的研究，并确定了一组检索关键词，以确保研究的坚实可靠。随后，运用 VOSviewer 软件开展文献计量 go 共现分析。

第三阶段，基于第二阶段精炼后的数据构建数据集，运用 VOSviewer 进行共被引分析，为文献计量研究提供有力支撑。VOSviewer 是一款免费软件，能够生成多种类型的文献计量图谱，如合著、引用、词共现、文献耦合等[18]。图谱以线条方式勾勒出研究对象（如论文、作者、机构和国家）之间的关联网络[18]。节点间距离的远近直观地反映了它们之间的关联强度，而不同颜色则用于区分不同的网络组群（或聚类），便于识别和分析。这些图谱能够帮助研究人员更好地解读文献计量分析的结果[19]。

2.1　第一阶段：共现分析

共现指同一语境中共同出现的词汇集合[20]。本研究对 1 126 篇文献的关键词（作者关键词和数据库加工关键词）进行了共现性分析，以研究相关词汇之间的关联。通过构建词汇间的共现网络，生成了一系列聚类结构，每个聚类包含一个或多个核心节点。这一分析能够精准识别与家庭食物浪费的发生机制及其预防策略最为相关的词汇和术语群。

2.2　第二阶段：共被引分析

在第二阶段，采用共被引分析方法，通过计算文献间的相互引用频率来确定文章之间的关系[18]。优化了 Web of Science 数据库中的检索词，引入了"Generation"，最终形成检索式："Food waste AND Generation AND（Household OR Behavior OR Behaviour）"，并排除 anaerobic digestion、life cycle assessment 和 life-cycle assessment。经过筛选，本阶段最终纳入 226 篇文献进行深入分析。

借助 VOSviewer 软件对选定文献进行分析，构建了基于共被引关系的聚类图谱。共被引是一种共现关系，当两篇文献被第三方研究同时引用时，即形成共被引关系[18]。软件根据文献主题和共被引强度对聚类进行组织分类。

2.3　系统分析

为进行系统分析，需对每个聚类中的文献进行全面阅读和回顾。这一过程使我们能够识别并突出每个组的主题重点，同时考察关键的文献计量指标，如总链接强度和每篇文章的引用次数。系统性分析不仅有助于深入理解各聚类的概念结构及其相关性，这种结构化的组织方式还有助于强化对第二阶段研究的吸收，同时为共被引分析结果的条理清晰、深入透彻的解读提供了支撑。

3　结果

3.1　第一阶段：共现分析

VOSviewer 采用了一种算法来识别与中心主题相关的术语，该算法能够自动识别论文和介词[21]。在分析过程中设定关键词出现的最低阈值为 10 次，在 4 692 个关键词中，有 179 个符合这一标准。图 1 展示了共现分析生成的三个聚类结果：红色（聚类 1）、绿色（聚类 2）和蓝色（聚类 3）。

文本分析结果表明，聚类 1（图 1 中标注为红色）与人类行为相关，人类行为是食物浪费产生的主要驱动因素。这一聚类中的"行为"和"产生"两个关键词具有最高的语义关联强度。该聚类包含"消费""减少""消费者""可持续性""损失""预防"等词汇。此外，"家庭""各家各户""家庭食物浪费"等词汇的出现，表明了该聚类对个人行为习惯和家庭层面致使食物浪费的关注。同时，"消费者行为"这一词汇的引入，凸显了在此背景下理解消费者动机和决策过程的重要性。

聚类 2（图 1 中标注为绿色）聚焦于食物浪费的技术与系统性管理，"食物浪费"的总链接强度最高，达 3 359。该聚类包含"生命周期评估""城市固体废弃物""厌氧消化""家庭垃圾""废物管理"等词汇，反映了对完善废物处理解决方案的重视。"沼气""堆肥""有机废物"等词汇的出现表明，该聚类探索了将有机废弃物转化为能源或肥料的技术路径。此外，"排放""甲烷"等词汇进一步强调了该聚类在减缓气候变化和推动可持续发展方面的联系。
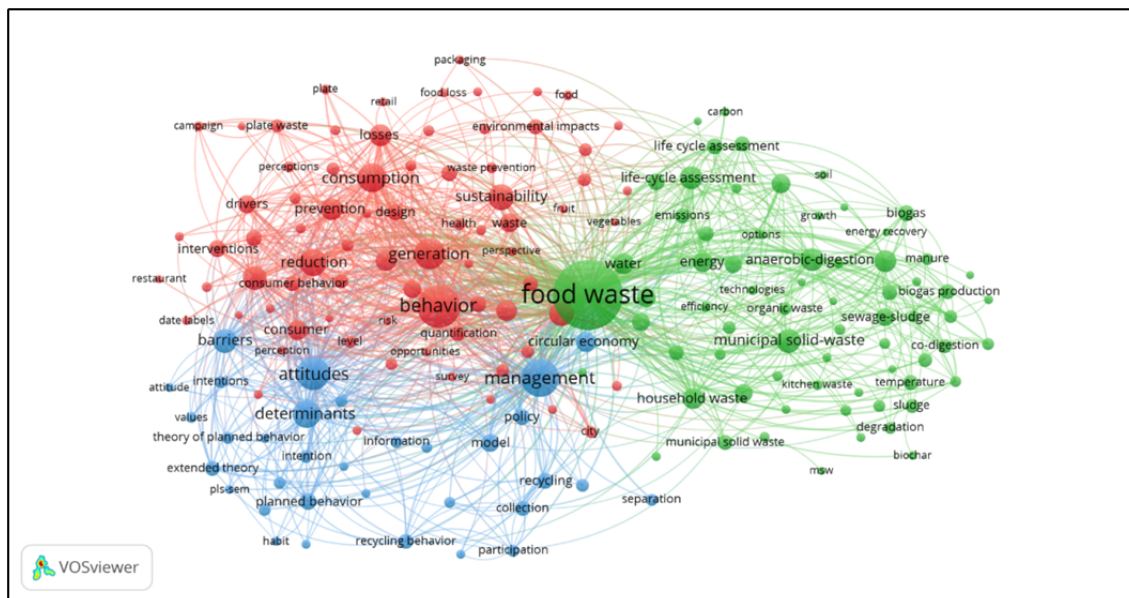
聚类 3（图 1 中标注为蓝色）强调影响废物管理的心理、社会和结构因素，"管理"的总链接

图 1   基于所有关键词的共现图谱

Fig.1   Co-occurrence map using all keywords

强度最高，达 1 171。该聚类包含"态度""决定因素""障碍""循环经济""政策"等词汇，表明研究人员对废物管理中行为驱动因素和政策相关方面的高度关注。此外，"计划行为""计划行为理论""回收利用""源头分类"等词汇的出现，表明该聚类运用心理学理论在解释废物管理行为。"意图""知识""动机"等词汇的纳入，突出了个人认知与集体意识在推动可持续废物管理实践中的作用。

本研究确定的三个聚类之间相互协同关联，通过互补共同应对家庭食物浪费问题。

（1）聚类 1 着重探讨了消费者行为在食物消费与浪费生成中的核心作用，强调预防性行为在减少家庭食物浪费中的关键地位。该聚类指出，需要通过针对性的干预措施，引导消费者形成可持续的食物消费模式。

（2）聚类 2 则将食物浪费置于更广泛的环境管理框架内，重点关注其与废物管理、水资源利用及污水污泥处理之间的相互作用。这些因素会影响固体废弃物处理的总体效果。

（3）聚类 3 进一步拓展了研究视角，引入心理和行为决定因素，包括个体对废物管理的态度、感知障碍以及循环经济理念的影响。基于扩展的计划行为理论，该聚类探究了个人动机与结构性限制对食物浪费行为的综合影响，为设计有效的

可持续废物管理干预措施提供了参考。

鉴于本研究关注家庭食物浪费的产生与预防机制，聚类 1 涵盖了与这一现象（即"产生"）最相关的关键词。因此，该关键词被纳入纳入标准。其他聚类中识别出的若干关键词则被归入排除标准，具体包括"厌氧消化""生命周期评估"等。

3.2   第二阶段：共被引分析

以聚类 1 的关键词为基础，选取"食物浪费""产生""行为""家庭行为""家庭"作为检索关键词。为避免引入其他聚类的内容，"厌氧消化""生命周期评估"等被排除。经过检索，共获得 226 篇相关科研论文。利用 VOSviewer 软件共识别出 8 496 条参考文献，设定"至少被引用 20 次"为筛选标准，最终筛选出 53 条参考文献，并通过共被引分析生成 3 个聚类。

图 2 通过共被引分析识别出 3 个聚类：红色（聚类 1）、绿色（聚类 2）和蓝色（聚类 3）。其中，"食物生态系统"（聚类 1）包含了科学论文关注规划不足、消费行为习惯以及社会经济因素之间的相互作用。"供应链与衡量"（聚类 2）的文献将家庭食物浪费置于更广泛的生态系统中进行考察，强调了供应链、零售商和废物管理基础设施的重要性。"扩展的计划行为理论及其补充"（聚类 3）的研究包含分析家庭食物浪费的影响因素，这些因素是对"对行为的态度""感知行为
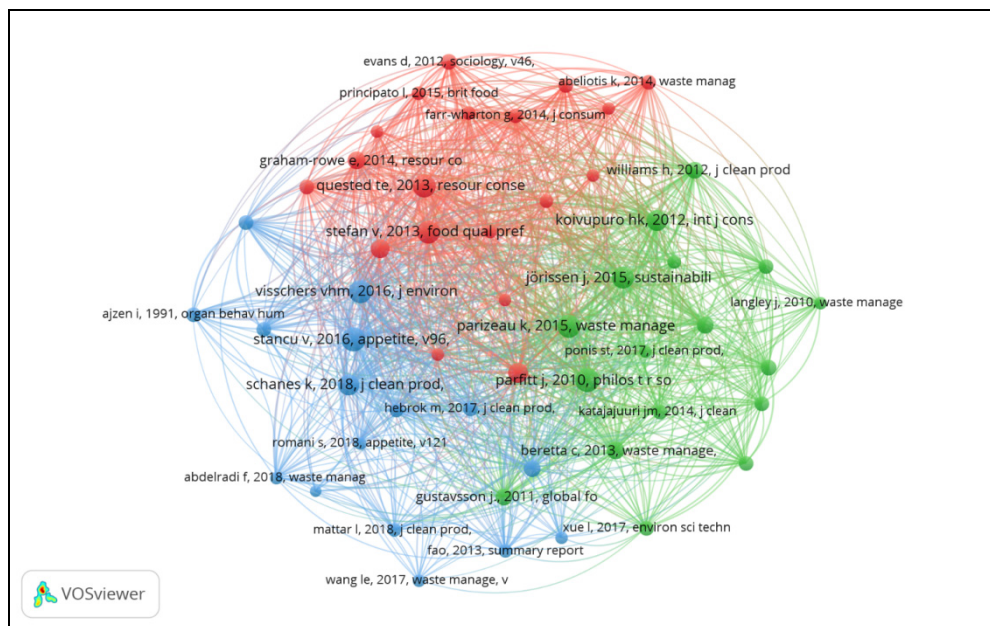
图 2　按聚类划分的共被引图谱
Fig.2　Co-citation map by cluster

控制""道德规范"等理论的补充。

3.2.1　聚类 1：食物生态系统

聚类 1（图 2 中标注为红色）中的文献将家庭食物浪费视为一种多维度社会现象，突出了合理规划、日常行为习惯与社会经济因素之间的交互作用。该聚类通过分析食物评估标准和既有生活习惯模式，理解食物浪费的发生机制。其中，Stefan 等[22]的研究具有重要影响力，其被引量高达 71 次，总链接强度为 1 635。研究表明，合理的规划、规律的购物习惯以及有效的食物供应策略有助于避免过量采购，从而减少家庭食物浪费。Quested 等[23]强调了食物浪费行为的复杂性和多面性。这两项研究均认为，日常行为模式和习惯性消费可能导致食物获取与消耗之间的脱节，最终引发食物浪费问题。

根据 Secondi 等[24]的研究，家庭食物浪费现象并非单纯由个人行为决定，而是受到多重社会经济和环境因素的显著影响。多层次分析框架显示，城市化进程、教育水平以及政策环境等结构性因素在其中发挥着关键作用。研究进一步指出，外部变量与个人行为交互作用对产生家庭浪费的总量具有一定影响。

Aschemann-Witzel 等[25]认为，消费者动机和食物管理技能在减少浪费方面具有重要作用。他们的研究表明，有效的食物规划和处理能力，以及对浪费行为环境和经济影响的认知，有助于可持续消费习惯的形成。为促成更显著的行为改变，不仅需要考虑激励因素，还需关注实际限制条件[25-26]。

3.2.2　聚类 2：供应链管理与衡量机制

总链接强度最高的 4 篇论文，均与食物供应链各环节中的损失和浪费的管控及计量相关。这些论文确定了衡量食物浪费的合适方法，找出了供应链中产生浪费最多的环节，并分析了其可能的成因。与该聚类中的其他论文相比，Parizeau 等[27]、Parfitt 等[8]、Jörissen 等[28]以及 Koivupuro 等[29]的论文总链接强度最高。

在聚类 2 中，Parizeau 等[27]的论文总链接强度最高。该论文聚焦于剖析食物浪费现象，深入探究其产生与购物习惯、食物预处理方式、垃圾处理措施以及对食物浪费的态度等因素之间的关系[8]。该论文也认可多部门协作对于减少食物浪费的重要性，并且指出，当本可避免产生的食品浪费被丢弃时，供应商、生产商和零售商都会共同承受经济负担。

食物浪费是一个贯穿整个食物供应链的问题，不仅限于家庭消费环节，还涉及生产、加工、运输、销售和消费等多个环节[27]。研究表明，食

物损失和浪费的产生与供应链各阶段的基础设施限制、技术瓶颈以及知识差距密切相关，这些因素共同导致了大量食物的浪费[8,27-28]。消费者的购物习惯也对食物浪费产生影响，例如，仅在超市购买食物的消费者往往会产生更多的食物浪费，这可能与其对食物价值的认知有关[28]。此外，过度购买、购买前未充分评估食物质量以及利用特价促销活动等因素都会增加食物浪费的可能性[27-28]。此外，购物频率与食物浪费呈正相关，而较长的购物规划周期可能导致过度购买，最终导致更多食物被丢弃[28]。

有效减少食物浪费需要供应链各环节参与者、零售商与消费者之间的跨部门协作[8]。系统性干预措施，如优化食品配送效率、重新设计零售营销策略等，能够在多层面有效减少食物浪费[30]。此外，供应商、生产商与废物管理机构的协同努力不仅有助于缓解可避免的食物浪费带来的经济负担，还能推动食品生态系统的可持续发展[8]。零售商和食品公司对消费者行为及浪费产生具有重大影响[8]。研究表明，大包装规格、促销折扣和批量购买选项往往会导致消费者过度购买，从而增加食物浪费[31]。

3.2.3 聚类 3：扩展的计划行为理论及其补充

聚类 3（图 2 中标注为蓝色）探讨了与计划行为理论（Theory of planned behavior，TPB）所提出的概念（包括态度、社会规范及感知控制）互补的理论框架，其中主要是道德规范和饮食习惯这两个关键变量。在该聚类中，Stancu 等[32]的研究具有较高的学术影响力，其文献被引用 78 次，总链接强度达 1 135。他们研究了个人规范在食物浪费行为形成过程中的作用机制，结果表明，道德义务感和饮食习惯对个人减少食物浪费的意愿具有显著作用。

Visschers 等[33]和 Graham-Rowe 等[34]提出了"动机与障碍"的概念，揭示了新的影响食物浪费行为的结构因素，包括个人规范、对食物供应者身份的认同、感知到的健康风险、厨房垃圾分类、对清洁生活环境的认知以及减少生活不便的意愿等。与食物浪费相关的负面情绪会显著影响个体减少浪费的意愿和行为程度，凸显了非认知

决定因素的作用[35]。

从行为调节的视角来看，食物浪费分析往往始于那些具有自我行为调节意识的个人或家庭。这种意识通常源于因需要向亲朋提供充足食物而产生的社会、经济或环境影响的内疚感[36-37]。然而，这种担忧也受个人经济状况的影响，如人们对食物价格的关注程度[36]。因此，培养个人或家庭对食物浪费的认识和态度，需要持续强化其对食物浪费对个人和社会造成影响的认知。

鉴于消费者与家庭的生活方式特征与食物浪费行为的密切关联，此聚类对其进行了研究。当个体将食物浪费与内疚等负面情绪相联系时，他们更倾向于培养有意识的消费习惯，强化膳食规划，更加积极地对剩余食物进行再利用[37]。此外，饮食健康程度、购买新鲜食品以及个人价值观（如宗教信仰和物质主义）等多重因素也与食物浪费行为密切相关。

环境或背景对个体行为的影响具有决定性作用，这种影响源于多种因素的相互作用[38]。在计划行为理论的基础上，引入道德规范、自我认同和后悔心理等结构因素，以及良好供应者身份认同和个人规范等变量，能够有效预测食物浪费行为[26,33,37]。Rusell 等[35]构建了一个模型，该模型融合了计划行为理论、人际行为理论和环境行为模型，旨在证明行为的非认知决定因素、习惯以及情感在行为决策中的作用。

此外，该聚类强调了心理与社会因素在食物浪费行为中的关作用[32]。具体而言，内疚感和预期后悔等情绪反应会显著影响个人减少浪费的意愿，从而强化道德规范与个人价值观的约束力[37]。同时，社会身份和家庭动态，包括责任认知与文化期待，也在塑造食物管理策略和处置习惯方面发挥着重要作用[32]。这些研究发现表明，在分析食物浪费行为时，认知、情感和社会决定因素之间存在着错综复杂的交互关系。

聚类 3 探讨了心理社会因素在食物浪费产生机制中的作用，强调了这些因素作为家庭食物浪费核心决定变量的重要性[32]。研究发现，个人态度、感知行为控制、社会规范和个人价值观等心理社会因素共同塑造了与食物消费和处置相关的

决策过程[32,35-36]。此外，该聚类还关注了内疚、责任感和道德义务等情绪对浪费行为的调节作用，指出有必要通过行为干预措施来促进食物管理和可持续消费习惯的形成[26,33,37]。

4 结论、未来研究方向及影响

4.1 结论

本研究基于文献计量分析方法，系统梳理了与家庭食物浪费产生机制相关的科学研究进展。研究分为两个阶段：第一阶段通过共现分析技术，筛选出解释食物浪费行为的相关文献；第二阶段在此基础上运用共被引分析方法，进一步识别理解家庭食物浪费行为的核心问题。在研究初期，为确保文献检索的精准性和相关性，不仅要制定涵盖食物浪费、行为特征及产生机制等方面的纳入标准，还须排除像"厌氧消化""生命周期评估"等特殊关键词。

在第二阶段研究，更好地识别出与消费者食物浪费行为决定因素相关的科学文献。研究结果形成了 3 个聚类，分别从不同维度对食物浪费问题进行了系统分析：一是食物生态系统视角，二是供应链与衡量机制，三是扩展的计划行为理论。食物浪费行为已被广泛研究，研究范围主要集中在其产生、管理和处理方面。总之，本研究的主要贡献在于构建了 3 个相互关联的知识体系，分别对应食物浪费产生的不同维度。

第一个聚类将家庭食物浪费视为一个由规划不足、习惯行为和社会经济因素所塑造的多维度问题。Stefan 等[22]强调，不良的购物习惯和缺乏规划会导致过度购买食物，最终增加浪费。同样，Quested 等[23]强调了习惯性消费模式在导致食物获取与利用脱节方面的作用。Secondi 等[24]认为，这一观点对浪费行为的影响分析可以通过纳入更广泛的社会经济因素来扩展，如城市化、教育和公共政策。此外，Aschemann-Witzel 等[25]和 Graham-Rowe 等[26]强调了消费者动机、情绪反应和实际问题在决定家庭食物浪费水平方面的作用。总体而言，这表明应针对个人行为和结构决定因素制定有效的干预措施，以促进可持续消费[25-26]。

值得注意的是，第一个聚类还涵盖了影响家庭食物浪费行为的多维度文献，体现了相关研究的不断深化与拓展。研究了更广泛的食物生态系统的各个方面，包括教育、城市化和政策法规，如何与个人决策过程和消费模式相互作用。通过分析这些相互关联的因素，本研究阐明了推动家庭食物浪费的复杂动态，为更全面、有效的食物浪费预防提供了基础。

第二个聚类研究了供应链中的食物浪费问题，确定了产生浪费的关键领域及其根本原因。Parizeau 等[27]强调，食物浪费受到食品配送和零售包装的影响，并指出供应链基础设施的低效、技术限制以及消费者行为会导致大量的浪费[8,28]。购物习惯在减少浪费方面具有决定性影响，习惯于超市购物的消费者群体往往由于受到促销活动的驱动，倾向于大量囤积商品，这种购物模式往往导致浪费[28]。

最近的研究还强调了环境因素日益增长的重要性，包括份量大小、保质期标签、用于食品保鲜的先进包装技术以及鼓励非计划性购买的营销战略，如折扣和促销活动[9,39-40]。解决食物浪费问题需要供应链上的参与者、零售商、政策制定者和消费者之间的紧密合作，以提高配送效率、重新设计营销策略并实施教育项目[30]。

最后，第三个聚类通过扩展的 TPB 来研究食物浪费问题，强调个人规范、情感和心理社会因素的影响，个体的道德规范意识、对浪费行为的后悔情绪，以及社会规范和同伴压力等心理因素，均在不同程度上影响消费者的浪费行为。Stancu 等[32]强调，道德和习惯会显著影响个人减少浪费的意愿，而 Visschers 等[33]和 Graham-Rowe 等[34]引入了其他因素，如感知到的健康风险因素、便利性与可及性以及对供应商的身份认同感。同样，Mattar 等[37]和 Schanes 等[36]表明，内疚感和经济状况在食物浪费中也起到了一定作用。

这一聚类体现了学术界对家庭食物浪费问题探讨的成熟度，整合了扩展的计划行为理论框架。结合互补的心理和社会行为模型，能够更全面地分析态度、感知行为控制、道德规范和社会影响等关键心理社会因素对食物浪费行为的综合影响。通过这种多维度的理论视角，研究者得以深

入剖析家庭食物管理实践中个体决策背后的认知和情感驱动机制，为制定有效的消费者层面干预措施提供了参考。

总之，社会和道德规范以及经济因素在塑造减少家庭食物浪费的意愿方面起着关键作用。社会规范通过社会期待和同伴压力对个体行为产生影响，道德规范则源于个人的价值观念和对食物浪费的伦理关注。在经济因素方面，人们对浪费食物的机会成本感知以及节约食物的潜在收益预期，进一步激励了减少浪费的行为选择。理解这些影响为设计更有效的干预措施，以促进可持续的食物消费实践提供了有价值的见解。

4.2 未来研究方向

未来的研究集中在 3 个关键主题上，旨在改变导致家庭食物浪费的行为和习惯，从而减少食物浪费。这些主题包括食物浪费行为的决定因素、食物环境的影响，以及促进家庭负责任的食物消费和再利用的潜在解决方案。此外，研究家庭基础设施、心理影响以及社交媒体的作用等方面，可能会进一步揭示食物浪费行为[36,41]。最终，综合不同研究的结果和实证证据将有助于巩固关于家庭食物浪费行为决定因素的知识。

同样，探索食物环境的作用对于理解与食物浪费相关的行为和习惯很有必要。Xu 等[39]、Mookerjee 等[14]和 Luo 等[15]强调了包装、折扣、标签、份量大小和食物价格等因素在影响食物浪费行为方面的重要性。认识到食物环境在塑造日常采购习惯、态度、道德价值观和行为方面起着关键作用，未来的研究应致力于深入探究多样化食物供应场景（如餐馆、超市、小型零售店及传统农贸市场）中消费者行为模式、食品安全管理机制及供应链效率等关键议题[42-44]。

进一步的研究应探索移动设备和电子商务对过度购买食物行为的影响。此外，研究公司对刺激因素和商业项目的负责任整合和管理也是必要的。通过沟通和先进技术，可以产生解决食物浪费问题的创新解决方案，从而在家庭中建立更可持续、更高效的食物管理系统。一些新兴技术有望减少家庭食物浪费，如智能冰箱、具有膳食规划和库存管理功能的食物应用程序、智能储存容器、智能包装等。

4.3 对未来的影响

为更好地减少家庭固体废弃物的产生，需要采取多方面的方法，包括开展环境意识宣讲活动，端正对食物浪费的态度，强化道德规范、责任感和资源节约意识[12]。然而，个人在试图改变非环保行为时可能会遇到障碍。因此，以规范环保行为的公共政策为工具进行宣教活动，并促进公共和私人机构之间的合作愈加重要。公共政策工具，如法规、激励措施和宣传项目，可以促使个人做出承诺，有效地减少家庭食物浪费。

在努力减少食物浪费方面，有几个关键建议值得关注，比如使用小包装食品、利用技术来鼓励可持续的生活习惯，以及在销售点开展有影响力的环境意识广告宣传。此外，地方层面的食物浪费监测项目在评估家庭食物供应者行为影响方面具有重要作用。通过实施激励措施，这些项目能够有效推广有意识消费和健康饮食习惯，从而在社区层面强化负责任的食物消费行为。

减少家庭食物浪费的一个关键方法是将行为学洞察融入到预防工作中。了解食物丢弃背后的心理和社会驱动因素，有助于设计出有针对性的干预措施，以解决行为改变过程中面临的特定障碍。例如，采用一些助推手段，如在冰箱内设置视觉提醒或提供份量指导，能够在不施加限制的情况下影响消费者的行为。同样，在超市实施动态定价模式，即随着保质期临近对易腐食品进行打折促销，能够促使消费者养成更负责任的购买行为。加强零售商与技术供应商之间的合作，能够进一步提高食物浪费监测系统的有效性，确保干预措施既以数据为驱动，又能适应当地的消费模式。

利益冲突声明：作者声明不存在利益冲突。

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2. 英文原文详见 P12-20。

Global Research Perspective on Household Food Waste Prevention (英文原文)

Christiam MÉNDEZ-LAZARTE[1], Victor BOHORQUEZ-LOPEZ[2],
Ammer GHOULEH-GRUNDL[1], María Ángeles RAMÓN-JERÓNIMO[3]

(1. Universidad de Lima, Lima, Peru 15082; 2. Pontificia Universidad Católica Madre y Maestra, Santiago, Dominican Republic 51000; 3. Universidad Pablo de Olavide, Seville, Spain 41013)

Abstract: Food waste remains a pressing global challenge, with households as major contributors. Understanding its key drivers is essential for fostering sustainable consumption practices. This study employs a bibliometric analysis, using co-occurrence and co-citation networks, to map the evolution of research on household food waste prevention, identifying key themes and influential works. The co-citation analysis reveals three major research clusters: (1) food ecosystems, (2) supply chains and measurement, (3) the expanded Theory of Planned Behavior and complements in explaining the psycho-social factors influencing household food waste. Findings indicate a shift in research focus from waste management toward prevention, emphasizing policy interventions, behavioral nudges, and consumer awareness. This study contributes to the sustainability discourse by identifying critical research gaps and future directions for more effective food waste prevention. Through mapping the intellectual landscape of food waste research, this work offers valuable insights for policymakers, researchers, and practitioners seeking to minimize household food waste.

Key words: bibliometric analysis; food waste prevention; household waste; consumer behavior; sustainability; food policy; global research perspective

Food waste is a critical global challenge, with approximately 1.3 billion tons discarded annually across the supply chain[1]. According to the Food and Agriculture Organization (FAO), nearly one-third of all food produced for human consumption is lost or waste, exacerbating food insecurity, environmental degradation and economic inefficiencies[2]. The Food Waste Index further highlights that household-level waste accounts for a significant portion of this waste[3]. Given the scale of the issue, reducing food waste has become a priority for governments, policymakers and researchers worldwide[3-4].

Efforts to reduce food waste extend beyond ethical and economic considerations, as such initiatives also have significant environmental implications. Avoidable food waste contributes to greenhouse gas emissions, excessive freshwater use and land degradation, further straining natural resources[1,3].

Businesses and policymakers promote sustainability and enhance economic efficiency by addressing the issues, minimizing supply chain losses and optimizing resource allocation[5-6]. Consequently, it is imperative to implement effective interventions across the food system to advance the achievement of sustainable development goals[4].

Reducing food waste aligns directly with global sustainability objectives, the United Nations sustainable development goal (SDG) 12.3, which aims to halve per capita global food waste by 2030[7]. Reducing food waste requires comprehensive policy measures that integrate environmental, economic and social perspectives[3].

The ecological footprint of food waste spans the entire supply chain, from production to disposal[8]. Agricultural expansion driven by excessive food demand contributes to deforestation and soil depletion, while transportation and storage processes further amplify carbon emissions[9]. Once discarded, food waste in landfills generates methane, a greenhouse gas with a warming potential significantly higher than carbon dioxide, worsening climate change[10]. Mitigating the environmental impacts necessitates a coordinated effort among policymakers, businesses and consumers, fostering systemic changes and promoting sustainable consumption habits[3].

In response to the challenges of food waste, prevention and recovery initiatives have emerged, including awareness campaigns, redistribution programs and regulatory frameworks[11]. The Asian-Pacific Economic Collaboration [APEC] conducted research showing that all economies, regardless of their level of development, have made progress in planning, leadership, and governance in FLW[12]. Nevertheless, most still lack adequate data collection systems. Although governance structures exist, only a few economies have established clear FLW reduction targets[12]. However, disparities are identified in the creation and implementation of policy instruments, with developed economies having well-defined frameworks, while developing ones are still designing their mechanisms[12]. Approaches that underscore the effectiveness of multi-level interventions in mitigating food waste play a crucial role in sustainability efforts[4].

Understanding food waste dynamics is essential for advancing research on sustainability and consumption behaviors[11]. Since households contribute significantly to food waste, researchers need to conduct further studies to explore behavioral drivers and assess the effectiveness of intervention strategies[11,13]. Investigating such patterns will contribute to the development of evidence-based policies that promote sustainable consumption and production practices[4]. Therefore, continued efforts are vital to promote food waste reduction at multiple societal levels.

Our research allows us to update our understanding and identify new trends in research by combining the bibliometric analysis method with a bibliographic review to identify keywords related to the problem of the generation and prevention of food wastage at home. Additionally, it seeks to identify the various approaches whereby the problem of the generation and prevention of food wastage at home has been addressed, as well as examining the relationships between publications that allow the identification of the base articles of each approach. This study aims to identify the evolution and most relevant topics of the most important publications. Furthermore, by analyzing the clusters that represent research perspectives, we aim to categorize and interpret the different theoretical and methodological frameworks that have shaped the field, providing a comprehensive overview of its development and future directions.

1　THE SEARCH TERMS DEFINED

Food waste and food loss are two distinct but related concepts, food loss occurs along the supply chain before reaching consumers, often due to inefficiencies in harvesting, storage and transportation. The United Nations Environment Programme[3] defines food waste as food and the associated inedible parts removed from the human food supply chain and those inedible parts as food that are not intended to be consumed by humans.

In contrast, food waste mostly occurs at the retail and consumer levels, driven by over-purchasing, poor meal planning and confusion over expiration labels[14-15]. Since households generate a significant share of global food waste, 53% in some estimates, recent research increasingly emphasizes the importance of tackling food waste rather than food loss to maximize environmental and economic benefits[16].

Food waste can be classified into avoidable and unavoidable categories[17]. Avoidable food waste includes edible food discarded due to spoilage, over-purchasing, or mismanagement, such as uneaten leftovers and expired products[16-17]. Unavoidable

food waste consists of inedible parts like bones, eggshells and fruit peels that cannot be consumed[17]. While consumers cannot completely eliminate unavoidable waste, they can significantly lower environmental impacts by reducing avoidable food waste through improved practices[3].

A key distinction in this research is between prevention and recycling: prevention focuses on reducing waste generation through better purchasing and storage habits, while recycling repurposes waste through composting or energy recovery. However, many have concentrated on recycling rather than prevention, despite evidence that prevention has a greater potential to reduce overall food waste. Due to the complexity of food waste behaviors, researchers delimit the field by focusing on specific factors such as consumer attitudes, economic constraints, and policy measures. The use of co-occurrence analysis to examine keyword relationships in food waste studies is essential for identifying research gaps and key themes, as well as providing insights into emerging trends and priorities for waste reduction efforts[3].

In this context, this research focuses on defining prevention as the reduction of food wastage at home, following the perspective of UNEP[3]. Clearly specifying this field is essential for understanding the relationships among studies. To establish the keywords that define these concepts, this study will first perform a co-occurrence analysis of keywords from articles related to food waste and households.

2 RESEARCH METHODOLOGY

A structured two-phase approach guided the comprehensive analysis of the scientific literature on food waste. This approach aimed to refine the selection of relevant studies, ensuring a focused examination of key research themes. The bibliometric analysis was conducted using data retrieved from the Web of Science database, enabling a rigorous evaluation of academic publications. Additionally, bibliometric techniques were employed to analyze relationships between studies, providing deeper insights into research trends and knowledge structures. This methodological framework ensures a strong foundation for understanding the academic discourse on food waste.

In the first phase, the initial search was conducted using the Web of Science Core Collection with the Science Citation Index Expanded (SCI-EXPANDED). The search string: Food waste AND (Household OR Behavior OR Behaviour) was applied for the period 2003–2024 (consulted on February 28, 2025). The search was restricted to journal articles, yielding an initial set of 2 210 scientific articles. Subsequently, additional filters were applied, limiting the results to the Environmental Sciences category and selecting only articles published in English, resulting in a final dataset of 1 126 articles.

In the second phase, the inclusion criteria were further refined to food waste and generation and (behavior OR household behavior OR household). Moreover, the following exclusion criteria were applied: anaerobic digestion, anaerobic-digestion, life cycle assessment and life-cycle assessment. After applying the filters, the final dataset consisted of 226 scientific articles.

In the second phase, researchers reviewed prior studies on food waste and identified a set of keywords for the search to ensure a strong research foundation. A bibliometric co-occurrence analysis was then conducted using VOSviewer. In the third phase, the refined dataset from the second phase was used to build a database of Web of Science articles, followed by a co-citation analysis in VOSviewer to support the bibliometric examination.

VOSviewer is a free software capable of generating graphically representative bibliometric maps with various emphases, such as co-authorship, citations, keywords and bibliographic coupling, among others, taking citation data or occurrence data as references [18]. The maps outline the relationships presented by lines to link objects (e.g., papers, authors, organizations and countries) that share connections[18]. The physical distance highlights the relationship between the nodes and to distinguish the networks, different colors are utilized for each group (or cluster). The maps were designed for researchers to interpret the results of the bibliometric analysis[19].

2.1 Phase 1: Co-occurrence analysis

The term co-occurrence is defined as a group of words used in the same context together[20]. A co-occurrence analysis was applied, using words and terms from all keywords including author keywords and keywords plus of the 1126 articles. This analysis establishes relationships between words and terms, generating clusters with one or more nodes to select a cluster of words and terms that is most related to the problem of generating and

preventing food wastage at households.

2.2　Phase 2: Co-citation analysis

In Phase 2, researchers conducted a co-citation analysis to identify relationships between articles by calculating how frequently they were cited together in other studies[18]. In this phase, the Phase 1 search string was updated in Web of Science to include Generation, resulting in the following string: Food waste and Generation and (Household or Behavior or Behaviour). While the excluding keywords were anaerobic digestion and life-cycle assessment. This process resulted in a final selection of 226 articles.

The selected articles were examined using VOSviewer to create a map of clusters based on co-citations. Co-citation is a relation of co-occurrence that occurs when two items of the existing literature are cited together by another author[18]. The clusters were organized by software based on different themes and topics discussed in the articles, as well as the number of co-citations related to the clusters.

2.3　Systematic analysis

To conduct a systematic analysis, we performed a thorough literature review by reading all the articles within each cluster. This process allowed us to identify and highlight the thematic focus of each group while examining key bibliometric indicators such as total link strength and the number of citations per article. By organizing the literature in this way, we aimed to gain a deeper understanding of the conceptual structure of each cluster and its relevance. This organization was designed to enhance the comprehension of Phase 2, ensuring a

more structured and insightful interpretation of the co-citation analysis results.

3　RESULTS

3.1　Phase 1: Co-occurrence analysis

VOSviewer identifies terms related to central topics using an algorithm that automatically recognizes papers and prepositions[21]. The analysis set a minimum threshold of 10 keyword occurrences, and out of 4 692 keywords, 179 met this criterion. Figure 1 illustrates the three clusters generated by the co-occurrence analysis: red (cluster 1), green (cluster 2), and blue (cluster 3).

Cluster 1 (red in Figure 1) is related to human behavior as the main driver of food waste generation, with the terms behavior and generation having the highest total link strength respectively. This cluster includes words such as consumption, reduction, consumer, sustainability, losses and prevention. Moreover, the presence of household, households, and household food waste indicates a focus on individual and domestic practices that contribute to food waste. Meanwhile, the inclusion of consumer behavior highlights an interest in understanding consumer motivations and decision-making processes in this context.

Cluster 2 (green in Figure 1) is centered on the technical and systemic management of food waste, with food waste having the highest total link strength of 3 359. This cluster includes words such as life-cycle assessment, municipal solid-waste, anaerobic digestion, household waste and waste management, reflecting an emphasis on waste
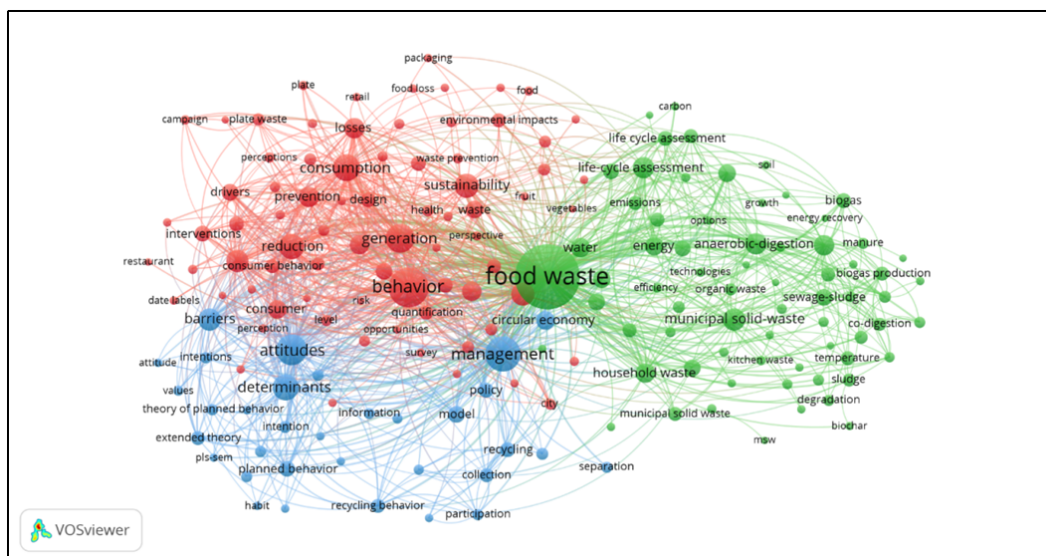
Fig.1　Co-occurrence map using all keywords

processing solutions. The presence of terms like biogas, composting and organic waste suggests that this cluster explores technologies for converting waste into energy or fertilizers. Furthermore, terms like emissions and methane reinforce its connection to climate change mitigation and sustainability.

Cluster 3 (blue in Figure 1) emphasizes the psychological, social, and structural factors that influence waste management, with "management" showing the highest total link strength of 1 171. This cluster includes words such as attitudes, determinants, barriers, circular economy and policy, indicating a strong emphasis on behavioral and policy-related aspects of waste management. Furthermore, the presence of planned behavior, theory of planned behavior, recycling and source separation suggests that this cluster applies psychological theories to explain waste management behaviors. The inclusion of intentions, knowledge and motivation highlights the role of individual and collective awareness in fostering sustainable waste management practices.

The three clusters identified in this study interconnect synergistically to address household food waste from complementary perspectives.

(1) Cluster 1 highlights the significance of consumer behavior in food consumption and waste generation as a central factor in sustainability efforts, emphasizing the role of prevention behavior in reducing household food waste. This cluster highlights the need for targeted interventions that promote sustainable food practices.

(2) These efforts are further shaped by cluster 2, which situates food waste within broader waste management, water utilization, and sewage-sludge treatment influence the overall impact of solid-waste disposal.

(3) In turn, cluster 3 extends this perspective by incorporating psychological and behavioral determinants, such as attitudes toward waste management, perceived barriers, and the influence of circular economy principles. Grounded in the extended theory of planned behavior, this cluster examines the influence of individual motivations and structural constraints on food waste behavior, providing insights into the effectiveness of interventions designed to promote sustainable waste practices.

Considering that this research focuses on the generation and prevention of food waste at households, Cluster 1 contains the most relevant keywords related to this phenomenon, generation. Therefore, this keyword has been incorporated into the inclusion criteria. However, the other clusters have identified keywords to be included in the exclusion criteria, including anaerobic digestion and life-cycle assessment.

3.2 Phase 2: Co-citations analysis

Seeking to identify the scientific papers related to the keywords of cluster 1, food waste and generation were considered search keywords, as well as behavior, household behavior and household. To avoid considering other clusters in the search, the keywords anaerobic digestion, anaerobic digestion, life cycle assessment and life-cycle assessment were excluded, leaving us with 226 scientific papers. VOSviewer identified 8 496 references, among which those with at least 20 citations were considered, resulting in only 53 references and generating three clusters through the analysis of co-citations.

Figure 2 depicts the three clusters generated by the co-citation analysis: red (cluster 1), green (cluster 2) and blue (cluster 3). The first cluster, Food ecosystem considers scientific papers focused on the interplay between inadequate planning, habitual practices and broader socio-economic influences. The second cluster, Supply chain and measurements considers papers that focus on household food waste within a broader food ecosystem, acknowledging the role of supply chains, retailers and waste management infrastructure. The third cluster, extended and complements of the Theory of Planned Behavior considers papers that focus on identifying factors of food wastage at home that complement Attitude toward the behavior, Perceived behavioral control, moral norms, etc.

3.2.1 Cluster 1: Food ecosystem (red in Figure 2)

Cluster 1 contains articles examining household food waste as a multidimensional phenomenon, highlighting the interplay between adequate planning, habitual practices and broader socio-economic influences. This cluster identifies food evaluation criteria and established routines to understanding food waste. The main reference in this cluster is Stefan et al. being the research with the most citations (71) and total link strength (1 635)[22]. The findings indicate that adequate planning, regular shopping routines, and effective food provisioning
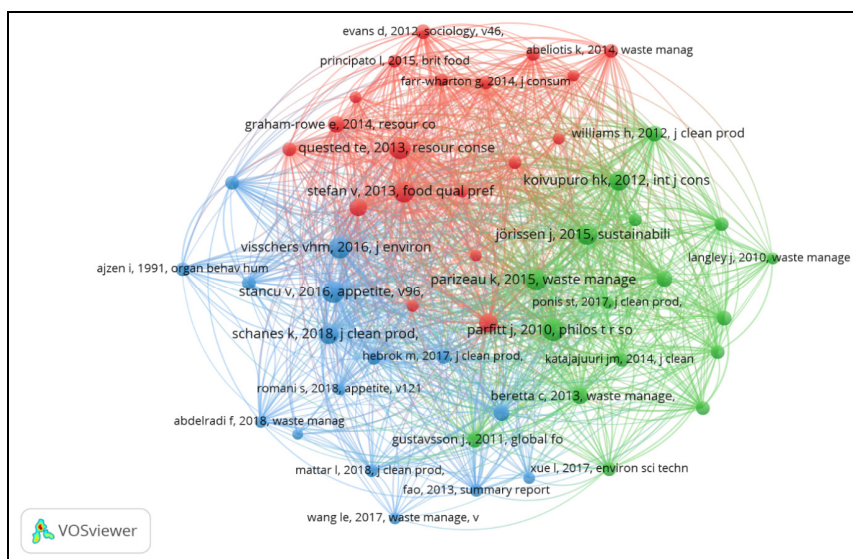
Fig.2　Co-citation map by cluster

help prevent over-purchasing and reduce household food waste. Furthermore, Quested et al. emphasize the complex and multifaceted nature of food waste behaviors[23]. Stefan et al. and Quested et al. argue that daily routines and habitual actions may create a disconnect between food acquisition and consumption, ultimately contributing to food waste.

Secondi et al. employ a multilevel analytical framework to demonstrate that household food waste is not solely driven by individual actions but is also significantly shaped by socio-economic and contextual factors, such as urbanization, educational levels, and local policy environments[24]. In addition, external variables interact with individual behaviors to influence the overall magnitude of waste generated in households[24].

Furthermore, Aschemann-Witzel et al. argue that consumer motivation and food management skills are pivotal in reducing waste[25]. Their study emphasizes that effective food handling and planning, along with awareness of the environmental and economic impacts of waste, contribute to more sustainable consumption practices . Likewise, both motivational factors and practical constraints need to be considered to foster significant behavioral change[25-26].

3.2.2　Cluster 2: Supply chain and measurements (green in Figure 4)

The four papers with the greatest total link strength are related to the operation and measurement of food losses and wastage throughout the supply chain, identifying adequate ways to measure waste, the stages of the chain that generate the greatest amount of waste and their possible causes. Parizeau et al. , Parfitt et al., Jörissen et al. and Koivupuro et

al. have a highest total link strength compared to other papers in the cluster[8,27-29].

Parizeau et al. with the highest total link in Cluster 2, focused on understanding food waste as the relationships between food waste production and factors such as shopping habits, food preparation, waste management practices and attitudes toward food waste[27]. Likewise, acknowledges the importance of multi-sectoral collaboration to reduce food waste, as well as the economic burden shared by suppliers, producers and retailers when avoidable food waste is discarded.

Food waste occurs across the entire food supply chain, encompassing production, marketing, and consumption, rather than being confined to households[27]. In addition, highlights that food losses and waste stem from infrastructure limitations, technological constraints and knowledge gaps at various stages of the supply chain that generate the most waste[8,27-28]. Shopping habits also influence food waste, as consumers purchase food exclusively from supermarkets tend to discard more, potentially reflecting the perceived value of food[28]. Buying in excess, failing to evaluate food quality before purchase and taking advantage of special offers increase the likelihood of waste[27-28]. Moreover, frequent shopping is associated with increased waste, while a longer planning horizon may lead to over-purchasing, ultimately resulting in greater food disposal[28].

Effectively mitigating food waste requires multi-sectoral collaboration across supply chain actors, retailers and consumers[8]. Systemic interventions, such as enhancing food distribution efficiency, redesigning retail marketing strategies can help

reduce food waste at multiple levels[30]. Besides, coordinated efforts among suppliers, producers and waste management entities can alleviate the economic burden of avoidable food waste while promoting sustainability in the food ecosystem[8]. Retailers and food companies significantly shape consumer behavior and waste generation[8]. Large packaging sizes, promotional discounts and bulk purchasing options contribute to excessive buying, which often leads to increased food waste[31].

3.2.3 Cluster 3: Extended and complements of the Theory of Planned Behavior

This cluster (blue in Figure 2) explore complementary constructs to those proposed by the Theory of Planned Behavior (TPB) (attitude, social norms and perceived control), the main ones being moral norms and eating routines. Stancu et al. with most citations (78) and total link strength (1 135) among the cluster, examine the role of personal norms in shaping food waste behaviors, highlighting that moral obligations and habits significantly influence individuals' intentions to minimize waste[32].

Visschers et al. and Graham-Rowe et al. proposed food waste behavior against motivations versus barriers, revealing new constructs, such as personal norms, good provider identity, perceived health risks, sorting kitchen waste, the perception of living in a clean area and the desire to minimize inconvenience[33-34]. Negative emotions related to food wastage influence both the intention to reduce it and the extent of food waste behavior, highlighting the role of non-cognitive determinants[35].

The analysis of food wastage starts from the individual or households that have an awareness that regulates their behavior, going from guilt due to the social, economic, or environmental effects of the need towards providing abundant food to their loved ones[36-37]. However, that concerns are based on individual financial issues, such as the importance that people give to the price of food[36]. Therefore, to foster this awareness or attitude in individuals or households, the recollection of the individual or societal effects of food wastage must remain consistently present[36].

The lifestyle of consumers and households is also examined within this cluster, as it is closely linked to food waste behavior. Individuals that associate food waste with negative emotions such as guilt, are more likely to adopt conscious consumption habits, enhance meal planning and make greater efforts to repurpose leftovers[37]. In addition, factors such as healthier diets, consumption of fresh products,

and personal values, like religiosity and materialism, have also been linked to food wastage[37].

The effect of the environment or context on people's behavior is crucial as it is understood as a complex interrelation of factors[38]. The extension of the TPB with additional constructs such as moral norms, self-identity and regret, as well as the identity of the good provider and personal norms, are significant predictors of food waste[26,33,37]. Besides, Russell et al. proposed a model that integrates the theory of planned behavior, the theory of interpersonal behavior and the model of environmental behavior to demonstrate the effect of non-cognitive determinants of behavior, habits and emotions[35].

It also highlighted the role of psychological and social factors in food waste behavior[32]. For instance, emotional responses such as guilt and anticipated regret can influence individuals' intentions to reduce waste, reinforcing the impact of moral and personal norms[37]. Moreover, social identity and household dynamics, including perceptions of responsibility and cultural expectations, further shape food management practices and disposal habits[32]. The insights underscore the complex interplay between cognitive, emotional, and social determinants in understanding food waste behaviors.

Cluster 3 explores the role of psycho-social factors in food waste generation, highlighting their significance as key determinants of household food waste[32]. Factors encompass individual attitudes, perceived behavioral control, social norms, and personal values, all of which shape decision-making processes related to food consumption and disposal[32,35-36]. Likewise, this cluster examines emotions such as guilt, responsibility, and moral obligations influence waste-related behaviors, emphasizing the need for behavioral interventions that promote food management and sustainable consumption habits[26,33-37].

4 CONCLUSIONS, FUTURE AGENDA AND IMPLICATIONS

4.1 Conclusions

Based on a bibliometric analysis, this study synthesizes the advances in scientific research related to understanding the aspects that generate food waste at home. The research was implemented in two phases: the first phase sought to focus on the selection of papers related to explaining food waste behavior through an analysis of co-occurrences, the second phase utilized the results of the initial phase,

performing a co-citation analysis to identify issues related to understanding food waste behavior at home. In the initial phase, ensure a precise and relevant search, it was essential to apply not only inclusion criteria encompassing food waste, behavior and generation but also exclusion criteria for specific keywords such as anaerobic-digestion, anaerobic digestion, life cycle assessment and life-cycle assessment.

In the second phase, it was possible to have a better selection of scientific papers related to the components that determine consumers food waste. Overall, three clusters were obtained that analyzed the problem from different perspectives: food ecosystem, supply chain and measure and extended theory of planned behavior. Food waste behavior has been widely studied with the main focus being on generation, management and processing. Therefore, the main contribution of this study is the identification of three clusters representing different but related bodies of knowledge corresponding to the three aspects of food waste generation.

This first cluster explores household food waste as a multidimensional issue shaped by inadequate planning, habitual behaviors and socio-economic factors. Stefan et al. emphasizes that poor shopping routines and lack of planning lead to excessive food purchases, ultimately increasing waste[22]. Similarly, Quested et al. highlight the role of habitual consumption patterns contribute to the disconnection between food acquisition and utilization[23]. Secondi et al. emphasized this perspective can be expanded by incorporating broader socio-economic factors, such as urbanization, education and public policy, which influence waste behaviors[24]. Furthermore, Aschemann‑Witzel et al. and Graham-Rowe et al. underscore the role of consumer motivation, emotional responses and practical concerns in determining household food waste levels[25-26]. Collectively, suggest that effective interventions should target both individual behaviors and structural determinants to foster sustainable consumption[25-26]

Notably, the first cluster also encompasses the emergence and expansion of literature on the various aspects influencing household food waste behavior. Examines various aspects of the broader food ecosystem, including education, urbanization, and policy regulations, interact with individual decision-making processes and consumption patterns. By analyzing these interconnected elements, this study illuminates the complex dynamics driving household food waste, providing a foundation for more comprehensive and effective food waste prevention.

This second cluster examines food waste within the supply chain, identifying critical areas where waste occur and their underlying causes. Parizeau et al. emphasize that food waste is influenced by food distribution and retail packaging[27]. Highlighting that inefficiencies in supply chain infrastructure, technological constraints and consumer purchasing behaviors contribute to significant waste[8,28]. Moreover, shopping habits play a crucial role, as consumers rely on supermarkets tend to generate more waste due to bulk purchases and special promotions[28].

Recent studies have also highlighted the growing importance of environmental factors, including portion sizes, expiration date labels, advanced packaging technologies for food preservation and marketing strategies such as discounts and promotions that encourage unplanned purchases[9,39-40]. Addressing food waste requires collaboration among supply chain actors, retailers, policymakers and consumers to improve distribution efficiency, redesign marketing strategies and implement education programs[30].

Finally, the third cluster explores food waste through the extended Theory of Planned Behavior (TPB), emphasizing the influence of personal norms, emotions, and psycho-socio factors while constructs like moral norms and regret also have effect on food waste behavior. Stancu et al. highlight that moral obligations and habits significantly shape individuals' intentions to reduce waste[32], while Visschers et al. and Graham-Rowe et al. introduce additional factors such as perceived health risks, convenience and good provider identity[33-34]. Also, Mattar et al. and Schanes et al. show that guilt and financial concerns play a role in food waste decisions[36-37].

This cluster reflects the maturation of the discourse on household food waste by incorporating more theoretical frameworks, particularly the extended Theory of Planned Behavior. This perspective with complementary psychological and behavioral models, it offers a more comprehensive understanding of the influence of various psycho-social factors, such as attitudes, perceived behavioral control, moral norms, and social influences, shape individual decisions related to food waste. This approach allows for a deeper exploration of the cognitive and emotional mechanisms driving household food management practices, it provides insights into the effectiveness of targeted interventions in reducing food wastage at the consumer level.

In summary, social and moral norms, along

with economic considerations, play a crucial role in shaping the intention to reduce food waste at home. Social norms influence behavior through societal expectations and peer influence, while moral norms stem from personal values and ethical concerns about waste. Additionally, economic factors, such as the perceived cost of wasted food and potential savings, further motivate individuals to adopt waste-reducing behaviors. Understanding these influences provides valuable insights for designing more effective interventions to promote sustainable food consumption practices.

4.2　Future Agenda

The future research agenda focuses on three key themes aimed at modifying household behaviors and habits that contribute to reduce food waste. Themes include the determinants of food waste behavior, the influence of the food environment, and potential solutions to promote responsible food consumption and reutilization at home. Furthermore, investigating aspects such as the household infrastructure, psychology influences and the impact of social media could shed further light on food waste behavior[36-41]. Ultimately, synthesizing findings from different studies and empirical evidence would help consolidate knowledge regarding the determinants of food waste behavior in households.

Likewise, exploring the role of food environments is crucial in understanding behaviors and habits related to food waste. Xu et al., Mookerjee et al. and Luo et al. have highlighted the significance of factors such as packaging, discounts, labels, portion sizes and food prices in influencing food waste behavior[14-15,39]. Recognizing that the food environment has a pivotal role in shaping acquisition of routines, attitudes, moral values and behaviors, future research should focus on gaining a deeper understanding of the effect in various food providers like restaurants, supermarkets, small stores and traditional markets[42-44].

Further research should explore the influence of mobile and e-commerce on over-purchasing behaviors related to food. Moreover, Examining the responsible integration and management of stimuli and commercial programs by companies is crucial. Innovative solutions for addressing food waste can emerge through communication and advanced technologies, fostering a more sustainable and efficient food management system within households. Several emerging technologies hold promise in reducing food waste at home, including smart refrigerators, food apps with meal planning and inventory management, smart storage containers and intelligent packaging.

4.3　Implications

Improving the reduction of solid waste generation at home requires a multifaceted approach that includes both environmental awareness campaigns and the reduction of negative attitudes towards food waste, emphasizing moral norms, accountability and resource conservation[12]. However, individuals may encounter barriers in their attempts to change non-environmental behaviors. Therefore, it becomes essential to complement educational campaigns with public policy instruments that regulate environmentally conscious practices and foster partnerships between public and private institutions. Public policy instruments, such as regulations, incentives, and awareness programs, can generate commitments that empower individuals to effectively reduce food waste at home.

Several key recommendations stand out in the effort to minimize food waste, like utilizing small food packaging, incorporating technology to encourage sustainable routines and implementing impactful environmental awareness advertising at points of sale. Moreover, local food waste programs can play a vital role in monitoring the influences of household food providers. Such programs can promote stimuli that encourage mindful consumption and healthy eating habits, reinforcing responsible food practices at the community level.

A key approach to reducing household food waste is incorporating behavioral insights into prevention efforts. Understanding the psychological and social drivers behind food disposal would allow for the design of targeted interventions that address specific barriers to change. For instance, incorporating nudges, such as visual reminders in refrigerators or portion size guidance, can influence consumer behavior without imposing restrictions. likewise, the implementation of dynamic pricing models in supermarkets, perishable goods are discounted as expiration dates approach, can promote more responsible purchasing behaviors among consumers. Strengthening collaborations between retailers, and technology providers can further enhance the effectiveness of food waste monitoring systems, ensuring that interventions are both data-driven and adaptable to local consumption patterns.

Declaration of competing interest: the author declares that there is no conflict of interest.

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See in its Chinese version P1-11.