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Food Waste at the Early Stage of Family in Urban Area: A Case Study of Bogor City and Regency, West Java, Indonesia

Marnotrawstwo żywności na wczesnym etapie życia rodziny w obszarze miejskim: Studium przypadku miasta i powiatu Bogor, Jawa Zachodnia, Indonezja

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Abstract in English

Food loss and food waste have emerged as critical global challenges, with profound economic, environmental, and social implications. Each year, approximately 1.05 billion tons of food are lost or wasted worldwide, resulting in economic losses estimated at USD 1 trillion and accounting for nearly 10% of global greenhouse gas emissions. A significant portion of this waste occurs at the household level. In Indonesia, household food waste is estimated at 20.93 million tons per year, the highest in Southeast Asia. Contributing factors include rapid urbanization, evolving consumption patterns, and the increasing use of food delivery applications, which further exacerbate food waste in urban households. Despite substantial research in developed countries, there is a notable lack of studies examining how household characteristics, urban context, and food consumption management interact, particularly among early-stage families. This knowledge gap limits understanding of the determinants of sustainable household food waste management in emerging urban contexts and makes a rationale for taking up a study aimed at filling it.

The main objective of this study is to examine the relationships between selected socio-demographic characteristics, urban context, food consumption management practices, and sustainable household food waste management at early stage families. Specific objectives include defining the amounts of food waste and reasons for the waste of the main 15 categories of food, examining relationships between socio-demographic and economic factors and household food consumption management and sustainable household food waste management, investigating the influence of Practice Theory on food consumption management and sustainable household food waste management, and analysing the influence of urban characteristics on food consumption management and sustainable household food waste management, based on.

Corresponding research questions explore how the selected socio-demographic factors, Practice Theory dimensions, and urban characteristics – constituting 13 latent variables - influence food consumption management and sustainable food waste outcomes among early-stage families.

The 13 latent variables included: socio-demographics (presence of child, age, financial awareness); Practice Theory (competency and culinary skills, knowledge of food planning and composting, material and proper infrastructure); urban context (healthy lifestyle, online grocery shopping, culture of food sharing, religion) as determinants or independent variables. Food consumption management as a mediator variable and sustainable household food waste management as a dependent variable.

To operationalize the objectives, twelve research hypotheses were formulated in modelling, grounded in theoretical constructs and empirical evidence from the literature. Hypotheses 1–4 focus on socio-demographic characteristics, including the presence of children, the age of spouses, household size, and financial awareness. Hypotheses 5–7 are based on Practice Theory, emphasizing competency and culinary skills, knowledge of food planning and composting, and availability of materials and proper infrastructure as critical factors for effective food consumption management. Hypotheses 8–11 examine urban contextual factors, such as healthy lifestyle habits, online grocery shopping, culture of food sharing, and religion, which have a direct positive influence on food consumption management. Finally, Hypothesis 12 posits that food consumption management has a direct positive influence on sustainable household food waste management.

The research focuses specifically on early-stage families residing in urban areas of Bogor City and Bogor Regency. For clarity, operational definitions are provided: food waste encompasses all food and beverages obtained for household consumption that are subsequently discarded, including both edible and inedible items; early-stage families are couples aged 19–39 in 2024, navigating the initial stages of marriage and parenting, living together with or without children, with the eldest child under 12, and financially independent from extended family members; urban areas refer to regions with populations exceeding 1000000 inhabitants, high population density, social diversity, and predominantly non-agricultural occupations; and households are defined as groups of individuals living together, sharing meals from a common kitchen, typically parents and children. Respondents are typically heads of households responsible for managing finances, purchasing food, preparing meals, and managing household food waste.

The thematic scope of this study encompasses determinants of sustainable household food waste management, listed above as 13 latent variables. The spatial scope focuses on Bogor City, a densely populated urban area with approximately 1 078 351 residents in 2025, and Bogor Regency, with 5 427 068 residents in 2021. These areas were selected for their high population density, predominance of non-agricultural occupations, and representative urban features in Indonesia.

The study population comprises early-stage families as, residing in Bogor City or Bogor Regency and financially independent.. Single-parent or divorced families are excluded to minimize potential financial bias.

The time scope spans four years, including the literature review (October 2022–June 2024), development of research questions and the hypothetical model, research design, data

collection in Indonesia (July–October 2024), data analysis, interpretation, discussion, and dissertation writing. This temporal framework ensures that the findings reflect current trends in household food waste behavior among early-stage families.

This study employed a mixed-methods design combining quantitative and qualitative approaches to investigate sustainable household food waste management. The quantitative component consisted of face-to-face surveys using a structured Likert-scale questionnaire (1–5), informed by the literature review and the twelve-hypothesis theoretical model. The qualitative component involved in-depth interviews with selected respondents to gain nuanced insights into household food consumption and waste behaviors. Data collection proceeded in three stages: development of the questionnaire, administration of the survey, and follow-up interviews to deepen understanding of survey responses. A non-probability purposive sampling strategy was used to target early-stage families meeting the inclusion criteria, included in the operational definition.. A total of 350 respondents were successfully recruited, exceeding the minimum sample size required for Partial Least Squares Structural Equation Modeling (PLS-SEM) based on the ten-times rule. This sample size ensured sufficient statistical power for model testing and hypothesis evaluation. Data analysis combined descriptive statistics and PLS-SEM. Descriptive statistics explored socio-demographic characteristics, household food expenditures, and estimates of food waste across fifteen categorized food items, while PLS-SEM tested theoretical model relationships, evaluated measurement reliability and validity, and analyzed latent variable interactions. Key indicators, including Cronbach's alpha, Composite Reliability (CR), and Average Variance Extracted (AVE), were employed to ensure robust measurement model evaluation.

The study's feasibility was reinforced by Bogor's urban context, demographic diversity, and availability of secondary data from the Central Bureau of Statistics (BPS) and Bappenas. Trained enumerators ensured consistent and reliable data collection. Ethical considerations were rigorously addressed, with informed consent and data confidentiality protocols followed throughout the research. Collectively, the study design, sampling strategy, analytical approach, and operational feasibility support the methodological rigor and reliability of findings.

Considering the results, the socio-demographic and economic characteristics of surveyed households revealed that most husbands were aged 33–40 (63%) and wives aged 26–32 (51%). The majority had been married 5–10 years (60%), with household sizes of three to four members (88%) and one or two children (88%). Wives predominantly managed household food consumption (83%), reflecting sociocultural norms in Indonesia.

Household food management, encompassing meal planning, purchasing, storage, and cooking, often followed habitual routines that reduced waste. Most families reported monthly incomes of IDR 2 100 000 – 5 000 000 (51%) and food expenditures between IDR 1 000 000 – 2 000 000 (41%), indicating young, productive households with moderate spending patterns that influence food consumption and waste behaviors.

Analysis of household food waste across fifteen categories revealed that soup and curry were the most discarded (56 g/day), followed by beverages (47 g/day), fish (43 g/day), meat (35 g/day), and fresh fruit (26 g/day). Major causes included large portions, overcooking, spoilage, and inadequate storage. Perishable items were often discarded due to changes in texture and freshness, while plate leftovers, pots, and pans were primary sources of waste. Less perishable items, such as bread and snacks, contributed minimally. These patterns underscore the importance of proper portioning, storage, and awareness of consumption to reduce household food waste.

PLS-SEM analysis assessed thirteen latent variables across socio-demographic characteristics, Practice Theory aspects, and urban context. The outer model evaluation confirmed the reliability and validity of most constructs, with minor exceptions. Inner model analysis indicated that the presence of children negatively affected food consumption management (confirming hypothesis 1), while financial awareness, culinary competency, material infrastructure, healthy lifestyle, online grocery shopping, and religion positively influenced food consumption management (confirming hypothesis 4, 5, 7, 8, 9 and 11 respectively). Food consumption management exhibited a moderate positive effect on sustainable household food waste management. The age (hypothesis 2), household size (hypothesis 3), knowledge of food planning and composting (hypothesis 6), and culture of food sharing (hypothesis 10) were not statistically significant predictors. The findings demonstrate that effective food consumption management is central to sustainable household food waste reduction. Financial awareness enhances efficiency, whereas having a child poses challenges. Culinary skills and proper infrastructure enable better planning, portioning, and food utilization. Healthy lifestyles, online shopping, and religious values further support sustainable practices. Knowledge is insufficient without motivation, habit formation, and supportive resources. Collectively, these findings highlight the importance of a multidimensional approach combining socio-demographics, practical competencies, urban lifestyle, religious and cultural values, and material infrastructure to minimize household food waste.

In conclusion, early-stage families' food consumption and waste behaviors are shaped by socio-demographic factors, practical competencies, and urban contextual elements. Integrated interventions are recommended to enhance financial awareness, develop culinary skills, leverage cultural and religious values, and ensure adequate material resources and infrastructure. Such a holistic approach can improve consumption efficiency, reduce food waste, and contribute to broader sustainability goals.

The study is significant both theoretically and practically. From a scientific perspective, it contributes to knowledge on household food waste behavior in urban emerging contexts, providing a foundation for future research. Practically, the findings can guide policymakers, local governments, businesses, and families in designing targeted interventions, raising awareness, and promoting responsible consumption, thereby supporting the achievement of SDG 12.3.

The novelty of the study lies in its focus on early-stage families, a demographic and social group underexplored in the food waste literature. The novelty also stems from the applied multidimensional model that examines complex causal relationships among multiple determinants of sustainable household food waste management.

Limitations include the focus on household-level waste and the study's specificity to Bogor City and Regency, which may limit generalizability. Future research should consider different family stages, broader geographic areas, and additional food system components to expand understanding of sustainable household food waste management.

Abstract in Polish

Straty i marnotrawstwo żywności stanowią obecnie jedno z kluczowych wyzwań o charakterze globalnym, niosących istotne konsekwencje ekonomiczne, środowiskowe oraz społeczne. Szacuje się, że każdego roku na świecie traci się lub marnuje około 1,05 miliarda ton żywności, co generuje straty ekonomiczne rzędu 1 biliona dolarów amerykańskich oraz odpowiada za niemal 10% globalnej emisji gazów cieplarnianych. Znaczna część tych strat powstaje na poziomie gospodarstw domowych. W Indonezji ilość odpadów żywnościowych generowanych przez gospodarstwa domowe szacowana jest na 20,93 mln ton rocznie, co stanowi najwyższy poziom w regionie Azji Południowo-Wschodniej. Do głównych czynników sprzyjających temu zjawisku należą dynamiczna urbanizacja, zmieniające się wzorce konsumpcji oraz rosnąca popularność aplikacji do zamawiania żywności, które dodatkowo przyczyniają się do zwiększenia skali marnowania żywności w gospodarstwach domowych na obszarach miejskich.

Pomimo licznych badań prowadzonych w krajach rozwiniętych, w literaturze przedmiotu nadal obserwuje się niedobór analiz dotyczących wzajemnych relacji pomiędzy cechami gospodarstw domowych, kontekstem miejskim oraz sposobami zarządzania konsumpcją żywności, zwłaszcza w odniesieniu do rodzin znajdujących się na wczesnym etapie cyklu życia. Luka ta ogranicza możliwość pełnego zrozumienia determinant powstawania oraz zrównoważonego zarządzania odpadami żywnościowymi w gospodarstwach domowych funkcjonujących w rozwijających się środowiskach miejskich i stanowi uzasadnienie dla podjęcia niniejszego badania.

Głównym celem pracy jest zbadanie zależności pomiędzy wybranymi cechami społeczno-demograficznymi, kontekstem miejskim, praktykami zarządzania konsumpcją żywności oraz zrównoważonym zarządzaniem odpadami żywnościowymi w gospodarstwach domowych wśród rodzin znajdujących się na wczesnym etapie rozwoju. Cele szczegółowe obejmują: (1) okreslenie ilości oraz przyczyn marnowania żywności wg 15 podstawowych grup produktów żywnościowych; (2) identyfikację zależności pomiędzy wybranymi czynnikami społeczno-demograficznymi i ekonomicznymi a zarządzaniem konsumpcją żywności i zrównoważonym gospodarowaniem odpadami żywnościowymi w gospodarstwach domowych; (3) zbadanie wpływu czynników wskazanych w Teorii Praktyk (Practice Theory) na zarządzanie konsumpcją żywności i zrównoważone gospodarowanie odpadami żywnościowymi; a także (4) identyfikację wpływu cech środowiska miejskiego na zarządzanie konsumpcją żywności i zrównoważone gospodarowanie odpadami żywnościowymi. Odpowiadające powyższym celom pytania badawcze koncentrują się na określeniu,

w jaki sposób wybrane czynniki społeczno-demograficzne, wymiary Teorii Praktyk oraz cechy środowiska miejskiego wpływają na zarządzanie konsumpcją żywności oraz poziom zrównoważonego gospodarowania odpadami żywnościowymi wśród rodzin na wczesnym etapie cyklu życia.

W modelu badawczym uwzględniono 13 zmiennych ukrytych. Do czynników społeczno-demograficznych zaliczono obecność dziecka w gospodarstwie domowym, wiek oraz świadomość finansową. W ramach komponentów Teorii Praktyk uwzględniono kompetencje i umiejętności kulinarne, wiedzę dotyczącą planowania żywności i kompostowania oraz dostępność zasobów materialnych i odpowiedniej infrastruktury. Z kolei do cech kontekstu miejskiego zaliczono orientację na zdrowy styl życia, zakupy spożywcze online, kulturę dzielenia się żywnością oraz religię. Zarządzanie konsumpcją żywności w gospodarstwie domowym pełni w modelu rolę zmiennej mediującej, natomiast zrównoważone zarządzanie odpadami żywnościowymi w gospodarstwach domowych stanowi zmienną zależną.

W celu operacjonalizacji założeń badawczych sformułowano dwanaście hipotez badawczych, opartych na przesłankach teoretycznych oraz wynikach wcześniejszych badań empirycznych. Hipotezy 1–4 odnoszą się do cech społeczno-demograficznych: obecności dzieci w gospodarstwie domowym, wieku małżonków, wielkości gospodarstwa domowego oraz poziomu świadomości finansowej. Hipotezy 5–7 opierają się na założeniach Teorii Praktyk, podkreślającej znaczenie kompetencji kulinarnych, wiedzy dotyczącej planowania żywności i kompostowania oraz dostępności odpowiednich zasobów materialnych i infrastrukturalnych dla efektywnego zarządzania konsumpcją żywności. Hipotezy 8–11 dotyczą czynników kontekstu miejskiego, takich jak zdrowy styl życia, zakupy spożywcze online, kultura dzielenia się żywnością oraz religia, które mogą wywierać bezpośredni pozytywny wpływ na zarządzanie konsumpcją żywności. Hipoteza 12 zakłada, że zarządzanie konsumpcją żywności wywiera bezpośredni pozytywny wpływ na poziom zrównoważonego gospodarowania odpadami żywnościowymi w gospodarstwach domowych.

W celu zapewnienia jednoznaczności interpretacyjnej przyjęto następujące definicje operacyjne: odpady żywnościowe obejmują wszystkie produkty spożywcze i napoje nabywane do konsumpcji w gospodarstwie domowym, które następnie są wyrzucane, zarówno jadalne, jak i niejadalne; h; gospodarstwo domowe definiowane jest natomiast jako grupa osób mieszkających razem i korzystających ze wspólnej kuchni, najczęściej obejmująca rodziców i dzieci. Respondentami są członkowie lub członkinie gospodarstwa domowego,

odpowiedzialne za zarządzanie finansami, zakup żywności, przygotowywanie posiłków oraz gospodarowanie odpadami żywnościowymi.

Zakres podmiotowy badania obejmuje rodziny na wczesnym etapie rozwoju, czyli pary w wieku 19–39 lat (w 2024 r.), znajdujące się w początkowym okresie małżeństwa i rodzicielstwa, mieszkające razem z dziećmi lub bez dzieci, przy czym najstarsze dziecko ma mniej niż 12 lat, a gospodarstwo domowe pozostaje finansowo niezależne od dalszej rodziny; obszary miejskie to regiony liczące ponad 1 000 000 mieszkańców, o wysokiej gęstości zaludnienia, dużej różnorodności społecznej i dominacji zawodów pozarolniczych, zamieszkujące Bogor City lub Bogor Regency i pozostające finansowo niezależne. Z badania wykluczono gospodarstwa domowe prowadzone przez samotnych rodziców oraz osoby rozwiedzione, w celu ograniczenia potencjalnych zniekształceń wyników związanych z różnicami w sytuacji finansowej.

Zakres tematyczny niniejszego badania obejmuje determinanty zrównoważonego zarządzania odpadami żywnościowymi w gospodarstwach domowych, które zostały wskazane powyżej i obejmują 13 zmiennych ukrytych. Zakres przestrzenny badania obejmuje Bogor City, liczące około 1 078 351 mieszkańców w 2025 roku, oraz Bogor Regency, którego populacja wynosi 5 427 068 mieszkańców. Obszary te wybrano ze względu na wysoką gęstość zaludnienia, dominację zawodów pozarolniczych oraz reprezentatywność dla obszarów miejskich w Indonezji. Zakres czasowy badania obejmuje okres czterech lat i obejmuje następujące etapy: przegląd literatury (październik 2022 – czerwiec 2024), opracowanie pytań badawczych oraz modelu hipotetycznego, przygotowanie projektu badania, zbieranie danych w Indonezji (lipiec – październik 2024), analizę danych, interpretację wyników, dyskusję oraz przygotowanie rozprawy doktorskiej. Przyjęte ramy czasowe zapewniają, że uzyskane wyniki odzwierciedlają aktualne tendencje w zakresie zachowań związanych z marnowaniem żywności w gospodarstwach domowych wśród rodzin znajdujących się na wczesnym etapie cyklu życia.

W niniejszym badaniu zastosowano podejście mieszane (mixed methods), łączące metody ilościowe i jakościowe w celu analizy zrównoważonego zarządzania odpadami żywnościowymi w gospodarstwach domowych. Część ilościowa obejmowała badanie ankietowe realizowane metodą bezpośredniego wywiadu z wykorzystaniem ustrukturyzowanego kwestionariusza opartego na pięciostopniowej skali Likerta (1–5). Konstrukcja kwestionariusza została opracowana na podstawie przeglądu literatury oraz modelu teoretycznego obejmującego dwanaście hipotez badawczych. Część jakościowa polegała na przeprowadzeniu pogłębionych wywiadów z wybranymi respondentami w celu

uzyskania bardziej szczegółowego wglądu w zachowania gospodarstw domowych związane z konsumpcją żywności oraz jej marnowaniem. Proces gromadzenia danych przebiegał w trzech etapach: opracowanie kwestionariusza badawczego, realizacja badania ankietowego oraz przeprowadzenie wywiadów uzupełniających mających na celu pogłębienie interpretacji odpowiedzi uzyskanych w badaniu ankietowym.

W badaniu zastosowano celowy dobór próby o charakterze nieprobabilistycznym, ukierunkowany na rodziny znajdujące się na wczesnym etapie cyklu życia, spełniające kryteria włączenia określone w definicji operacyjnej. Łącznie pozyskano 350 respondentów, co przekracza minimalną liczebność próby wymaganą w analizach z wykorzystaniem metody Partial Least Squares Structural Equation Modeling (PLS-SEM) zgodnie z zasadą tzw. *ten-times rule*. Taka wielkość próby zapewniła odpowiednią moc statystyczną niezbędną do testowania modelu badawczego oraz weryfikacji postawionych hipotez.

Analiza danych obejmowała zastosowanie statystyk opisowych oraz modelowania równań strukturalnych metodą PLS-SEM. Statystyki opisowe posłużyły do charakterystyki cech społeczno-demograficznych respondentów, poziomu wydatków gospodarstw domowych na żywność oraz oszacowania skali marnowania żywności w piętnastu wyodrębnionych kategoriach produktów spożywczych. Z kolei metoda PLS-SEM umożliwiła testowanie zależności przewidzianych w modelu teoretycznym, ocenę rzetelności i trafności modelu pomiarowego oraz analizę interakcji pomiędzy zmiennymi ukrytymi. Do przeprowadzenia kompleksowej oceny rzetelności i trafności konstrukcji teoretycznych uwzględnionych w modelu badawczym wykorzystano współczynnik alfa Cronbacha, Composite Reliability oraz Average Variance Extracted.

Realizacja niniejszego badania była możliwa dzięki specyfice miejskiego kontekstu Bogoru, jego zróżnicowaniu demograficznemu oraz dostępności danych wtórnych pochodzących z Centralnego Urzędu Statystycznego (BPS) oraz Bappenas. W procesie zbierania danych uczestniczyli przeszkoleni ankieterzy, co zapewniło spójność oraz wysoką jakość gromadzonych informacji. W trakcie realizacji badania rygorystycznie przestrzegano zasad etyki badań naukowych, w tym procedury uzyskiwania świadomej zgody respondentów oraz zapewnienia poufności danych. Całościowo przyjęty projekt badawczy, strategia doboru próby, zastosowane metody analityczne oraz uwarunkowania organizacyjne potwierdzają wysoki poziom rzetelności metodologicznej oraz wiarygodność uzyskanych wyników.

Wyniki badania wskazują, że badane gospodarstwa domowe charakteryzują się określonym profilem społeczno-demograficznym i ekonomicznym. Większość mężów

znajdowała się w przedziale wiekowym 33–40 lat (63%), natomiast żony najczęściej w przedziale 26–32 lata (51%). Większość badanych par pozostawała w związku małżeńskim od 5 do 10 lat (60%). Gospodarstwa domowe najczęściej liczyły od trzech do czterech członków (88%), a liczba dzieci wynosiła jedno lub dwoje (88%). W większości przypadków zarządzanie konsumpcją żywności w gospodarstwie domowym należało do kobiet (83%), co odzwierciedla obowiązujące w Indonezji normy społeczno-kulturowe. Zarządzanie żywnością, obejmujące planowanie posiłków, dokonywanie zakupów, przechowywanie produktów oraz przygotowywanie potraw, często opierało się na utrwalonych rutynach, które sprzyjały ograniczaniu marnowania żywności. Większość rodzin deklarowała miesięczne dochody na poziomie od 2,1 mln do 5 mln rupii indonezyjskich (IDR) (51%), natomiast wydatki na żywność mieściły się najczęściej w przedziale 1 mln – 2 mln IDR (41%). Wskazuje to na młode, aktywne zawodowo gospodarstwa domowe o umiarkowanym poziomie wydatków, co może mieć istotny wpływ na wzorce konsumpcji żywności oraz zachowania związane z jej marnowaniem.

Badanie ilości odpadów żywnościowych, obejmujące piętnaście kategorii produktów, wykazało, że najczęściej wyrzucane były zupy i potrawy typu curry (56 g dziennie), następnie napoje (47 g dziennie), ryby (43 g dziennie), mięso (35 g dziennie) oraz świeże owoce (26 g dziennie). Do głównych przyczyn powstawania odpadów żywnościowych należały zbyt duże porcje przygotowywanych posiłków, nadmierne gotowanie, psucie się produktów oraz niewłaściwe przechowywanie żywności. Produkty łatwo psujące się były często wyrzucane ze względu na pogorszenie ich tekstury i świeżości, natomiast głównym źródłem odpadów były resztki pozostające na talerzach oraz pozostałości w garnkach i patelniach. Produkty o dłuższej trwałości, takie jak pieczywo czy przekąski, w znacznie mniejszym stopniu przyczyniały się do powstawania odpadów. Zaobserwowane wzorce podkreślają znaczenie właściwego planowania wielkości porcji, odpowiedniego przechowywania żywności oraz zwiększania świadomości konsumpcyjnej w celu ograniczenia marnowania żywności w gospodarstwach domowych.

Analiza z wykorzystaniem metody PLS-SEM (Partial Least Squares Structural Equation Modeling) objęła 13 zmiennych ukrytych reprezentujących cechy społeczno-demograficzne, elementy Teorii Praktyk (Practice Theory) oraz czynniki kontekstu miejskiego. Ocena modelu pomiarowego (outer model) potwierdziła rzetelność i trafność większości analizowanych konstrukcji, z niewielkimi wyjątkami. Analiza modelu strukturalnego (inner model) wykazała, że obecność dzieci w gospodarstwie domowym wywiera negatywny wpływ na zarządzanie konsumpcją żywności, co potwierdza hipotezę 1. Z kolei

świadomość finansowa, kompetencje kulinarne, dostępność infrastruktury materialnej, orientacja na zdrowy styl życia, zakupy spożywcze online oraz religia wywierają pozytywny wpływ na zarządzanie konsumpcją żywności, co potwierdza odpowiednio hipotezy 4, 5, 7, 8, 9 oraz 11. Zarządzanie konsumpcją żywności wykazało umiarkowany pozytywny wpływ na poziom zrównoważonego zarządzania odpadami żywnościowymi w gospodarstwach domowych.

Jednocześnie zmienne takie jak wiek respondentów (hipoteza 2), wielkość gospodarstwa domowego (hipoteza 3), wiedza dotycząca planowania żywności i kompostowania (hipoteza 6) oraz kultura dzielenia się żywnością (hipoteza 10) nie okazały się statystycznie istotnymi predyktorami. Uzyskane wyniki wskazują, że efektywne zarządzanie konsumpcją żywności stanowi kluczowy element ograniczania odpadów żywnościowych w gospodarstwach domowych. Świadomość finansowa sprzyja zwiększeniu efektywności gospodarowania żywnością, natomiast obecność dzieci może generować dodatkowe wyzwania organizacyjne. Kompetencje kulinarne oraz dostępność odpowiedniej infrastruktury umożliwiają bardziej efektywne planowanie posiłków, kontrolowanie wielkości porcji oraz lepsze wykorzystanie produktów spożywczych. Ponadto zdrowy styl życia, korzystanie z zakupów spożywczych online oraz wartości religijne sprzyjają kształtowaniu bardziej zrównoważonych praktyk konsumpcyjnych. Jednocześnie sama wiedza okazuje się niewystarczająca bez odpowiedniej motywacji, utrwalonych nawyków oraz dostępności zasobów wspierających właściwe praktyki. Łącznie wyniki te podkreślają znaczenie wielowymiarowego podejścia łączącego czynniki społeczno-demograficzne, kompetencje praktyczne, styl życia charakterystyczny dla środowiska miejskiego, wartości religijne i kulturowe oraz dostępność infrastruktury materialnej w celu ograniczenia marnowania żywności w gospodarstwach domowych.

Podsumowując, zachowania związane z konsumpcją i marnowaniem żywności wśród rodzin znajdujących się na wczesnym etapie cyklu życia kształtowane są przez złożony zestaw czynników społeczno-demograficznych, kompetencji praktycznych oraz elementów kontekstu miejskiego. W związku z tym rekomenduje się wdrażanie zintegrowanych działań obejmujących zwiększanie świadomości finansowej, rozwijanie kompetencji kulinarnych, wykorzystanie wartości kulturowych i religijnych oraz zapewnienie odpowiednich zasobów materialnych i infrastrukturalnych. Takie kompleksowe podejście może przyczynić się do zwiększenia efektywności konsumpcji żywności, ograniczenia jej marnowania oraz realizacji szerszych celów zrównoważonego rozwoju.

Przeprowadzone badanie ma znaczenie zarówno teoretyczne, jak i praktyczne. Z perspektywy naukowej wnosi ono wkład w rozwój wiedzy dotyczącej zachowań związanych z marnowaniem żywności w gospodarstwach domowych funkcjonujących w rozwijających się środowiskach miejskich, stanowiąc jednocześnie punkt wyjścia dla dalszych badań w tym obszarze. Z perspektywy praktycznej uzyskane wyniki mogą stanowić wskazówkę dla decydentów publicznych, władz lokalnych, przedsiębiorstw oraz gospodarstw domowych przy projektowaniu ukierunkowanych działań mających na celu ograniczenie marnowania żywności, zwiększenie świadomości społecznej oraz promowanie odpowiedzialnej konsumpcji, co przyczynia się do realizacji Celu Zrównoważonego Rozwoju ONZ 12.3.

Nowatorstwo niniejszego badania polega przede wszystkim na skoncentrowaniu uwagi na rodzinach znajdujących się na wczesnym etapie cyklu życia — grupie społecznej stosunkowo rzadko analizowanej w literaturze dotyczącej marnowania żywności. Dodatkowym elementem innowacyjnym jest zastosowanie wielowymiarowego modelu analitycznego umożliwiającego badanie złożonych relacji przyczynowo-skutkowych pomiędzy licznymi determinantami zrównoważonego zarządzania odpadami żywnościowymi w gospodarstwach domowych.

Do głównych ograniczeń badania należy koncentracja wyłącznie na poziomie gospodarstw domowych oraz ograniczenie przestrzenne do Bogor City i Bogor Regency, co może ograniczać możliwość generalizacji uzyskanych wyników. W przyszłych badaniach wskazane jest uwzględnienie innych etapów cyklu życia rodzin, szerszego zakresu geograficznego oraz dodatkowych elementów systemu żywnościowego w celu pogłębienia wiedzy na temat zrównoważonego zarządzania odpadami żywnościowymi w gospodarstwach domowych

Introduction

Food loss and food waste have become a major global concern with profound implications for economies, environments, and societies. Globally, food losses and wastes across the supply chain are estimated at 1.05 billion tons per year (UNO, 2024)). The economic cost of food loss and waste amounts to a staggering USD 1 trillion worldwide, rising to approximately USD 2.6 trillion when environmental and social impacts are considered. In Europe, the cost of food waste and loss amounts to approximately EUR 131 billion annually (Eurostat, 2021). Beside economic burden, food waste together with food loss generate nearly 10% of global greenhouse gas emissions and takes up the equivalent of nearly 30% of the world's agricultural land, causing habitat loss. It demonstrates that food loss and food waste represent not only inefficiency in resource use but also a structural challenge within the global food system.

A substantial proportion of food waste occurs at the household level. In 2022, it was estimated at 631 million tons globally, i.e., 79 kg per capita (UNO, 2024). In European countries, food waste generated at the household level rates up to 42% or 50% of total food waste generated across the food supply chain (Campoy-Muñoz et al., 2017). This also occurs in Indonesia, which has one of the largest populations in the world. The Food Waste Index (2021) reveals that household food waste in Indonesia reaches up to 20.93 million tons per year. This is the highest among Southeast Asian countries (ASEAN). This aligns with data from the Ministry of Development Planning in Indonesia, which shows an increase in food loss and waste during 2000–2019. Specifically, food waste production in Indonesia exceeds food loss every year.

Extensive research has focused on preventing household food waste in developed countries. Nevertheless, despite advances in such studies and the implementation of various initiatives, food waste levels have continued to increase and now represent a critical challenge in almost all countries. This persistence can be attributed, in part, to the fragmented nature of existing household-level interventions that lack consistency (Szabo and Saha, 2023). Moreover, many countries, including Indonesia, lack cohesive policy frameworks that comprehensively address food waste reduction while considering the influence of urban lifestyles and the specific needs of early-stage families (Martianto et al., 2024). These facts highlight the urgency of understanding household-level food waste dynamics, particularly in rapidly urbanizing societies.

Urban context plays a critical role in shaping household food waste patterns across many Asian countries (Wang et al., 2017; Shafy & Mansour, 2018; Wang YS, 2019). Food waste not only signifies the discarding of economic resources essential for sustaining the production cycle but also imposes significant global economic burdens. The increase in household food waste is most often generated in urban areas, which is also influenced by diverse consumer lifestyles (Witzel et al., 2021). Food waste in urban areas represents a significant global challenge (Bhatia et al., 2023; Liu et al., 2023; Pedrotti et al., 2023; Wong et al., 2023). Studies have shown that urban context exacerbates food waste issues by increasing consumption and disposal rates across households, retail stores, and food service establishments, among other levels (Bhatia & Sharma, 2023; Sahoo et al., 2023). Urban households generally generate more food waste than rural households due to differences in dietary diversity, purchasing frequency, and eating behaviors, according to a study conducted in Harbin, China (Rejman & Jeżewska-Zychowicz, 2023). Urban food systems are characterized by resource intensity, consumption-driven lifestyles, and ecological pressures that lead to significant food losses worldwide (Babbitt, 2020). In Asia, urban areas are witnessing a surge in household food waste, driven by the swift expansion of cities, evolving dietary habits, and changing lifestyles (Seto & Ramankutty, 2016; Hatab et al., 2019; Casari et al., 2022). Soma (2019) states that Indonesia contributes significantly to household food waste due to its large population.

Urban context reshapes daily food-related practices through lifestyle changes, multicultural interactions, and technological innovation (Szabo, 2015; Károly, 2019; Xu& Yang, 2023; Chikanda et. al., 2024). Urbanization involves changes in lifestyle, particularly in food consumption patterns. Different consumer lifestyles affect the amount of food waste generated (Witzel et al., 2021). In urban areas, there are diverse food preferences due to the heterogeneity of people. This condition encourages urban people to request a variety of foods. Different diets and eating habits (Liu et al., 2023) in urban areas generate more food waste than in rural areas. In addition, urban people spend money on food outside their homes, such as at HORECA (hotel, restaurant, and café). They are also using the food delivery applications to access their food. This way makes it easier for them because it saves their time. Urban people do not have extra time to cook at home because most are employed full-time. These habits have implications in urban areas, particularly for food consumption and food waste generation.

Rapidly advancing technology helps people in their daily activities, which also relates to food consumption behavior. As in urban areas, most people use food delivery applications to make ordering easier and save time (Kapoor & Vij, 2018; Li & Wang, 2022; Wang et al., 2025). However, it is not clear whether the food delivery application helps reduce or increases food waste. The heterogeneity of people raises multiculturalism in urban areas. It relates to how people prepare their meals, manage their food, and follow their diet. (Poulain et al., 2015; Lie et al., 2020; De Araújo et al., 2021). Some studies discuss the influence of religion on food consumption management, such as shaping food preferences and beliefs about reducing food waste (Shatenstein et al., 1993; Elimelech et al., 2023). Furthermore, there are limited studies addressing the urban context.

As the urban context continues to reshape consumption patterns, it is important to consider how economic factors intersect with these trends. Economic development considerations also play a role in food waste. Individuals with higher incomes tend to generate more food waste than those with middle-to-low incomes (Soma, 2020). Some researchers have deemed the impact of income on food waste production to be insignificant (Kavipuro et al., 2012; Witzel et al., 2015). However, economic factors, such as income level, must be considered to understand food waste production. This relates to spending money on food, which is the most fundamental human need. On the other hand reducing food waste is related to improving the family economy (Khusniyah et. al., 2022; Wraith R., 2022).

Addressing food waste not only improves food security but also reduces the ecological impact caused by irresponsible consumption, aligning with the Sustainable Development Goals for 2030 (Berenice, 2023), particularly SDG 12.3 by 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses. Implementing interventions tailored to household characteristics and behaviors can effectively reduce food waste and contribute to a more sustainable food system.

A sustainable food system (SFS) ensures that everyone has access to adequate nutrition and food security while maintaining the economic, social, and environmental foundations required to provide these conditions for future generations. The food system is currently facing numerous issues related to food security (Kwasek, 2023; Kwasek et al., 2018) and climate change. By 2050, more than 10 billion people are expected to inhabit the planet, increasing demand for food and straining limited resources. This is consistent with the findings of Fan et al. (2021), which states that the global food system

has many challenges, such as climate change, wars, the COVID-19 pandemic, the state of the economy, and the depletion of natural resources in the world. According to previous studies, the main primary driver of food insecurity and climate change is increased food waste production at the consumer level (Gustavsson et al., 2011; Foley et al., 2011; Tomlinson, 2013; Cloke, 2016). Given the complexity of global challenges, consumers play a crucial role in addressing food insecurity and climate change through their daily choices. Shifts in consumption patterns lead to variations in food preferences. Addressing these challenges is crucial not only to reduce pressure on limited resources but also to mitigate the resulting environmental impacts and to ensure a stable food supply and a sustainable food system for the global population. Sustainable food waste management practices are directly linked to household behavior, emphasizing the need for interventions to prevent food waste at the household level (Nik et al., 2022). To effectively manage household food waste in urban environments, it is necessary to understand each individual's intentions and behaviors in depth (Azam et al., 2023). This study aims to minimize financial bias and provide insights into food waste behavior within this specific demographic group in urban Indonesia. This approach allows for a more controlled analysis of how family dynamics, resource allocation, and household management strategies influence food waste practices.

The literature review revealed a **knowledge gap** concerning food waste generation at early stage of family in urban areas. Most previous studies have discussed the sociodemographic, social concern, and economic considerations of food waste issues (Koivupuro et al, 2012; Canali et al., 2017; Chen et al., 2021; Siedlecka et al., 2024) in different context. Several sociodemographic variables have been examined to determine food waste production, including household size, presence of children, level of knowledge about food waste, and education (Fox et al., 2018). However, there is a lack of literature exploring the relationship between a broader range of variables in a modelling form referring to early stage families in urban areas.

Most previous studies did not investigate food waste at a specific level within the household. In the early stages of family, few studies have examined the transition from life before having children to life after having children. Propino (2015) emphasizes the importance of understanding the transition from families without children or newly married families to families with children in terms of food waste generation. Therefore, it is essential to comprehend the early family stage of food waste generation.

Initially, this study will focus on the specific object, the family, in its early stage. A nuclear family consists of a couple and their children, typically one to three children, living in the same household.

This study also highlights the roles of economics and the environment in households' food consumption management. Conversely, some studies focus solely on marital satisfaction in the family life cycle. (Barros et al., 2019; Abreu-Afonso et al., 2021). The transition from single life to parenthood can lead to changes in food consumption management, particularly in food waste production. This study attempts to examine the economic and environmental aspects of food waste generation, accounting for family dynamics. Building on this, the relationship between urban context, the economy, and food consumption management can be effectively developed through the integration of interrelated models. Several studies have examined the relationship between these variables (Mathieu et al., 2016; Agheli & Emamgholipour, 2016).

More studies examine young consumers in relation to food waste, but previous studies have given limited attention to the early stages of families as the primary contributors to household food waste. A limited studies have focused on urban areas and specific family stages, particularly early-stage families. A comprehensive model can provide a broad explanation of household food waste management. Therefore, it is also important to consider socio-economic factors in the context of urban areas. An integrated model is needed to address the complexity of interactions among these factors. In household food waste management, where women dominate household arrangements, gender roles also need to be taken into account. Studies indicate that in many cultural contexts, women predominantly manage food in household settings, which, in turn, affects food waste patterns (Li et al., 2023; Ananda et al., 2023). Schanes et al. (2018) also state that traditional gender roles in food management have pivotal implications for food waste management at the household level.

Some previous studies have focused on food waste at the household level, however, this study examines the unique dynamics and factors that contribute to food waste in early-stage families, including the presence of children and the level of financial awareness among young families. Furthermore, this study addresses the knowledge gap regarding urban context and food consumption management to reduce food waste.

The main objectives of this study are to better understand the relationships among socio-demographics, Practice Theory, urban context, food consumption management,

and sustainable household food waste management at an early stage of family in a country with a large population (Indonesia).

The **novelty of this study** stems from reflecting on several interrelated dimensions. First, this research makes a significant contribution by focusing specifically on household food waste among early-stage families, a demographic group that remains underexplored in the existing food waste literature, particularly in emerging urban contexts. By focusing on early stage families, this study addresses a critical life stage characterized by dynamic consumption patterns, changing family structures, and heightened vulnerability to food waste. Second, this study advances existing research by examining the complex causal relationships among multiple determinants of sustainable household food waste management. Unlike prior studies that predominantly rely on single theoretical perspectives, this research adopts an integrative analytical framework that simultaneously incorporates sociodemographic characteristics (including presence of children, age, household size, and financial awareness), Practice Theory based factors (such as competencies and culinary skills, food planning knowledge, portion control, composting knowledge, and the availability of food management tools and infrastructure), and urban area related factors (including healthy lifestyle orientation, online grocery shopping, culture of food sharing, and religion influences). Third, this study enhances theoretical understanding of urban households by exploring the interrelationships between the Practice Theory constructs and sustainable household food waste management outcomes, while accounting for sociodemographic and urban context factors. In particular, it evaluates how everyday food-related practices and material conditions interact with household characteristics and urban lifestyles to shape food waste behaviors. This multidimensional approach enables a more nuanced understanding of food waste generation beyond attitudinal or awareness-based explanations.

This study is important for science and practice. This study can help researchers expand their understanding of sustainable household food waste management in the early stages of family life, while organizations, businesses, and government agencies can utilize the research findings to design effective strategies and interventions to reduce food waste in Indonesia, particularly in urban areas. This study can serve as a valuable resource for policymaking and decision-making. From a mitigation perspective, this study aimed to identify the most effective factors to reduce food waste at an early stage of family life. By understanding the factors that drive food waste, stakeholders can develop targeted interventions to raise awareness, improve practices, and promote responsible

consumption and production. In addition, this mitigation action can be implemented early in the food supply chain, particularly at the distribution and retail levels. The research findings have practical implications for individuals, families, food businesses, and local governments. By understanding the factors that contribute to food waste, individuals can make informed decisions regarding their consumption patterns, meal planning, and grocery shopping, particularly in their household. This can lead to more efficient resource use, reduced food waste, and financial savings.

1. Theoretical Background

1.1 Food Waste Definition and Categories

Food waste refers to food that is still edible but is lost or discarded at various stages of the food supply chain, from production and processing to distribution and consumption. This concept encompasses both unconsumed surplus food and wasted food, which collectively have significant social, environmental, ethical, and economic impacts globally (Ellison & Lusk, 2018; Gonçalves et al., 2023).

Food waste is categorized into edible and non-edible. Edible food waste refers to food intended for human consumption that is discarded due to factors such as overproduction, leftovers, inadequate storage, or consumer behavior. In contrast, non-edible food waste comprises inedible components of food, including bones, seeds, peels, and other parts that cannot be consumed. Edible food waste represents a direct loss of nutritional value, caloric content, and the economic and environmental resources invested in its production, processing, and distribution. It is estimated that approximately one-third of the food produced globally for human consumption is lost or wasted, with a substantial proportion consisting of edible food at the time of disposal (Varelas, 2019).

Food waste at the household level generally includes unused or partially consumed food, reflecting inefficiencies in food management and daily consumption behavior. Food waste reduction is a key element in achieving a sustainable food system. This effort involves implementing more effective food management practices, such as proper storage, portion control, menu planning, and redistribution initiatives to prevent excess food from becoming waste. Thus, food waste can be broadly understood as the portion of food originally intended for human consumption but ultimately lost or discarded throughout the food supply and consumption chain (Ellison & Lusk, 2018; Aktas et al., 2018; Gonçalves et al., 2023).Various studies indicate that the highest levels of food waste occur at the consumer level. At this stage, the decision to discard food is influenced not only by demographic characteristics but also by perceptions of food safety, economic considerations, and contextual factors such as consumption planning, attitudes toward household finances, and social relationship dynamics (Aktas et al., 2018). Furthermore, Zhang et al. (2020) stated that the decision to discard food is related not only to demographic characteristics such as age, education, and household composition, but also by perceptions of food safety and economic considerations. Studies show that consumers with positive

perceptions of food waste tend to generate less food waste, whereas those with negative perceptions generate more (Zhang et al., 2020).

1.2 Theory of Planned Behavior

The Theory of Planned Behavior (TPB), proposed by Ajzen (1991), is one of the most widely used theoretical frameworks for explaining pro-environmental behavior, including food waste management at the household level. This theory assumes that most human behavior is planned and influenced by cognitive processes that can be identified and systematically measured. In the context of household food waste, the Theory of Planned Behavior provides a comprehensive analytical framework for understanding how cognitive, social, and perceived control factors influence household decisions throughout the food consumption chain, from planning and purchasing, through storage, consumption, and disposal (Mak et al., 2020; Raj & Babu, 2021). Thus, the TPB enables the identification of key determinants of both the occurrence and prevention of food waste at the household level. Empirical studies referred to in this chapter demonstrated that the TPB is highly relevant for assessing sustainable food waste management behavior. This is due to the characteristics of food-related practices, which are generally planned, repetitive, and embedded in daily routines. Therefore, they are better explained by behavioral models that emphasize intention and control rather than by approaches that focus on impulsive actions (Chen, 2022). Consequently, the TPB has become one of the most dominant theoretical models in household food waste research, in both Western and non-Western contexts.

According to the TPB, individual behavior is primarily determined by behavioral intentions, which in turn are shaped by three main constructs:

a. attitude toward the behavior,
b. subjective norms, and
c. perceived behavioral control.

Attitudes reflect an individual's evaluation of a behavior, subjective norms describe the perceived social pressure to perform or not perform the behavior, and perceived behavioral control refers to an individual's perception of the ease or difficulty of performing the behavior. This framework has been widely applied in various fields, including health and environmental behavior, to predict intentions and actual behavior.

In the Indonesian context, recent studies adopting the TPB framework indicate that attitudes toward behavior are important determinants of household intentions to reduce food waste. Positive attitudes toward food conservation and responsible food management have been shown to correlate with lower levels of food waste. Increased awareness of the environmental, social, and economic impacts of food waste fosters more supportive attitudes toward waste reduction practices (Mganga et al., 2021; Setiawan et al., 2024). Furthermore, subjective norms also play a significant role in influencing an individual's intention to reduce food waste (Hazuchová et al., 2022). Social pressure from family, peers, and the broader social environment can encourage individuals to adopt more sustainable consumption and food management practices. In particular, among young people, peer attitudes and expectations have been shown to be powerful motivational factors in encouraging the adoption of food waste reduction behaviors (Mganga et al., 2021; Radde et al., 2024). Furthermore, perceived behavioral control reflects an individual's belief in their abilities and resources to manage food waste effectively. Research shows that higher levels of PBC, such as the ability to plan purchases, store food properly, and utilize leftovers, are positively correlated with both intention and actual behavior to reduce food waste (Damanik et al., 2024; Niha et al., 2022). This indicates that perceived behavioral control not only influences intention but also directly contributes to the implementation of behavior. While the three TPB constructs provide a strong understanding of the determinants of behavioral intention, several studies confirm that raising awareness alone is not always sufficient to sustain behavioral change.

These findings suggest the need for a more comprehensive approach that integrates stronger social norms and personal habit formation as an extension of the Theory of Planned Behavior framework to more effectively encourage household food waste reduction (Niha et al., 2022; Setiawan et al., 2024).

Research adopting the Theory of Planned Behavior (TPB) and its extended models shows that positive **attitudes toward food waste reduction** significantly increase individual's intention to engage in the behavior (Hatab et al., 2021; Schrank et al., 2023).

Attitude refers to an individual's positive or negative evaluation of food waste reduction behavior. In this context, favorable attitudes such as viewing food waste reduction as environmentally beneficial or a moral responsibility are consistently associated with stronger intentions to reduce food waste (Hong, 2022; Nazli et al., 2024). Empirical evidence and systematic reviews further confirm that attitude is among the strongest

predictors of food waste reduction intentions across diverse social, economic, and cultural contexts (Etim et al., 2024).

In urban contexts, including those in developing countries, attitudes, along with perceived behavioral control, have been identified as key determinants of intentions to minimize household food waste (Hatab et al., 2021). Similar findings have been reported among university students and hospitality workers, where positive attitudes and environmental concerns play a significant role in driving behavioral intentions to reduce food waste (Luu, 2020; Pandey et al., 2023; Melnyk et al., 2025). However, the literature also highlights that positive attitudes and intentions do not always translate into actual behavior. Studies in Malaysia show that urban households often express attitudes and intentions that support sustainable food waste management, yet the adoption of actual practices, such as composting, remains limited, indicate a gap between intention and behavior (Wong et al., 2023; Schrank et al., 2023). This gap confirms that favorable attitudes, while important, are not sufficient to ensure consistent behavior change.

Several factors have been identified as key drivers of this intention-behavior gap. These factors include low perceived behavioral control, limited availability or convenience of facilities, the dominance of habitual behavior, and psychological and situational barriers that hinder the realization of intentions (Salem & Wagner, 2025). Furthermore, the relationship between attitudes and behavior is influenced by other factors such as social norms, self-identity, and environmental awareness. Strong moral norms and a self-identity aligned with sustainability values can strengthen intentions and increase the likelihood of implementing food waste reduction behaviors (Luu, 2020). However, without simultaneously addressing external and internal barriers, the influence of positive attitudes on actual behavior is likely to remain limited (Pandey et al., 2023).

Attitudes toward food waste reduction are important predictors of behavioral intentions across various socio-demographic and cultural contexts. However, achieving significant food waste reduction requires interventions that specifically target the intention-behavior gap, through strengthening perceived behavioral control, increasing availability and convenience, leveraging social norms, and increasing environmental awareness. This understanding provides a theoretical and practical basis for designing intervention strategies at the individual, community, and policy levels to promote sustainable behavior change (Hatab et al., 2021; Schrank et al., 2023)

Several cross-cultural studies have shown that social and cultural contexts moderate the influence of subjective norms on behavioral intentions. **Subjective norms**

reflect perceived social pressure from family, peers, or the community to perform or avoid certain behaviors. In the context of food waste management, several studies emphasize the important role of normative influences in shaping behavioral intentions, particularly in collectivist societies, where social expectations strongly influence household practices (Nazli et al., 2024; Raj & Babu, 2021). The influence of subjective norms on household food waste is an example of such mechanisms. Previous studies have shown that the influence of subjective norms on food waste reduction intentions is not always consistent. Some studies found that subjective norms were a significant predictor of behavioral intentions (Hong, 2022; Chen, 2022), while others reported weaker or contextual influences, depending on cultural background and household characteristics (Randall et al., 2024).

In China, for example, both descriptive and prescriptive norms have been shown to exert a stronger influence on individuals' intention to prevent food waste than in more individualistic cultural contexts such as the United States, indicating a moderating role of culture on normative perceptions (Liu & Lapinski, 2024). Similar findings have been reported in Saudi Arabia, where subjective norms mediated the relationship between food consumption culture and food waste intention, along with attitudes and perceived behavioral control (Elshaer et al., 2021).

However, some studies have shown that subjective norms can compete with or interact with other psychological and situational factors. A study in Turkey, for example, highlighted prescriptive norms as a significant predictor of intention not to waste food, alongside guilt and perceived behavioral control (Aydin & Aydin, 2022). Conversely, research in the Indian restaurant context suggests that attitudes have a stronger influence than subjective norms, which have only a moderate effect on food waste reduction intentions (Wani et al., 2024). An expanded Theory of Planned Behavior-based study in the United States also revealed that moral norms and anticipated pride play a significant role in increasing food waste reduction and scrap reuse intentions, placing subjective norms within a more complex normative and moral landscape (Talwar et al., 2022). The variation in the strength of subjective norms in predicting food waste reduction intentions across contexts suggests that social norms do not operate universally, but are instead influenced by cultural values, collectivism-individualism orientations, and household structure and dynamics. These findings underscore the importance of a culturally context-sensitive approach in designing interventions and communication strategies that

effectively leverage normative influences to reduce food waste (Liu & Lapinski, 2024; Morkunas et al., 2024).

Perceived behavioral control reflects an individual's perception of their ability to perform food waste reduction behaviors. This construct encompasses beliefs about personal skills, resource availability, and the presence of external constraints that may facilitate or hinder the implementation of these behaviors. Within the Theory of Planned Behavior, perceived behavioral control plays a key role in shaping both intention and behavior. Higher levels of perceived control increase an individual's likelihood of engaging in food waste reduction behaviors by strengthening self-efficacy and minimizing perceived barriers. Numerous empirical studies consistently demonstrate that perceived behavioral control is one of the strongest predictors of both intention and actual food waste reduction behavior (Mak et al., 2020; Chen, 2022; Nazli et al., 2024; Schrank et al., 2023; Aydin & Aydin, 2022).

Factors influencing perceived behavioral control, such as time availability, adequate storage facilities, access to waste sorting and management infrastructure, and knowledge of appropriate food management practices, have been shown to significantly strengthen perceived control (Chen, 2022). When individuals have easy access to sorting and composting facilities, the perceived ease of engaging in waste-reduction behaviors increases, which, in turn, drives actual behavioral change (Schrank et al., 2023).

However, limited resources and facilities can undermine perceived behavioral control even when individuals have strong intentions. Wong et al. (2023) showed that low perceived behavioral control, primarily due to limited composting facilities and minimal institutional support, was a major barrier to the adoption of sustainable food waste management practices in urban households. These findings highlight the gap between intentions and actual behavior when structural barriers remain unaddressed. In addition to structural factors, psychosocial and situational factors also play a significant role in shaping perceived behavioral control. Environmental awareness and knowledge can enhance perceived control by equipping individuals with the skills and understanding necessary for food conservation and waste prevention (Gao et al., 2024). Meanwhile, demographic and lifestyle factors, such as time pressure, can decrease perceived behavioral control, while higher education and appropriate infrastructure tend to increase it (Pandey et al., 2023; Salem & Wagner, 2025).

Perceived behavioral control is a central construct in driving food waste reduction intentions and behaviors. Improving perceived behavioral control requires a

comprehensive approach that includes strengthening individual competencies through knowledge and skills, providing adequate resources, and reducing external barriers such as time constraints and weak institutional support. Without interventions to address these factors, strong intentions may fail to translate into sustainable food waste management practices (Chen, 2022; Schrank et al., 2023).

1.3 Social Cognitive Theory

The conceptualization of Social Cognitive Theory (SCT) was developed by Bandura (1986), who observed that human behavior results from dynamic interactions among personal, behavioral, and environmental determinants and the feedback they provide. At the individual level, there are some personal factors including basic knowledge, specific skills, attitude, and self-efficacy as fundamental to determine the personal capacity in how they behave. SCT has an important role in maintaining the food consumption, particularly among young people. Previous studies show that SCT is effective in decreasing fast food consumption and increasing the habit of promoting healthier food. Ahmadi et al. (2018) confirm that SCT interventions can reduce fast food consumption among students. In addition, there is an increase in the consumption of vegetables and fruits, indicating a shift in behavior that affects daily intake (Najimi & Ghafari, 2013; Hasheiman et al., 2022).

Food waste reduction behavior in young consumers is influenced by the interaction between cognitive and emotional responses, highlighting the importance of integrating affective and rational elements in interventions targeting household food waste. According to Attiq et al. (2021) and Ma et al. (2023), the interplay among cognitive awareness, cognitive factors (including perceived sustainability value), and emotional factors serves as a primary driver of waste-reduction intentions and behaviors. Social Cognitive Theory (SCT) emphasizes the critical roles of self-efficacy, outcome expectations, and emotional regulation in facilitating behavior change. Consequently, it provides a robust theoretical foundation for this study.

Within the realm of food consumption management, SCT underscores self-regulatory mechanisms, specifically goal setting, behavior monitoring, and outcome evaluation, as essential tools for sustainable individual action. While social and environmental factors like community engagement and social norms are influential, their impact is not always straightforward. This is highlighted by Habib et al. (2023), who observed that social

cohesion does not consistently lead to improved attitudes toward food waste. Ultimately, household behavior remains a complex reflection of personal beliefs and perceived behavioral control, aligning with SCT's core focus on individuals' perceptions of their ability to act. A study in Addis Ababa showed that positive attitudes toward food waste reduction and higher perceived control significantly predicted intention to reduce food waste, confirming that strengthening individual self-efficacy and capacity is a crucial prerequisite for sustainable household food management (Hatab et al., 2021).

SCT-based interventions can be designed by simultaneously leveraging cognitive, emotional, and social components. Educational campaigns help increase knowledge and awareness of the consequences of food waste, thereby strengthening the expected outcomes of waste-reduction behavior. Furthermore, emotional appeals such as the activation of anticipated guilt have been shown to increase motivation for sustainable food management (Attiq et al., 2021). Behavioral modeling through social media and community-based programs also supports behavior change by presenting realistic and achievable practices while reinforcing social norms that support sustainable consumption (Orea-Giner & Fusté-Forné, 2023). The sustainability of food waste reduction is further influenced by contextual factors, including sociodemographic characteristics, food purchasing habits, and individuals' perceived psychological distance from the consequences of food waste. Variations in young consumers' engagement with sustainable food practices indicate that cognitive and emotional perceptions are heterogeneous, requiring interventions to be tailored to the context and characteristics of the target group (Attiq et al., 2021; Falasconi et al., 2019).

Social Cognitive Theory provides a comprehensive conceptual framework for understanding and promoting household food waste management and sustainable food consumption. Dynamic interactions among cognitive aspects, emotional responses, self-control, social influence, and environmental cues demonstrate that Social Cognitive Theory explains how intention and behaviour relate to reducing food waste. Therefore, the effective intervention should be integrated holistically to push the sustainable behaviour change.

1.4 Practice Theory in Food Consumption Management

Practice Theory in food consumption management provides a comprehensive analytical framework for understanding cooking as a contextual social practice. This

approach emphasizes that culinary practices are shaped by the dynamic interaction of embodied skills, practical knowledge, material availability, and the social and cultural meanings attached to cooking and food consumption.

Empirically, Shove et. al. (2012) state that the Practice Theory framework has been widely applied in studies of consumption, sustainability, and technology adoption. This approach allows for a deeper understanding of how everyday behaviors, such as energy use, mobility, and health practices, are shaped by specific social configurations, and how changes in these practices can support social innovation and the achievement of policy goals, particularly in the environmental field. This includes managing food consumption to create sustainable household food waste management.

Social practice as the primary unit of analysis in understanding the phenomena and dynamics of social change. This theory views practice as an integrated configuration of three interrelated elements, namely: (1) material, (2) competence, and (3) meaning. These three elements interact dynamically and together support the continuity and transformation of social routines over time (Shove et al., 2012).

Within this framework, practice is not understood as simply individual behavior, but rather as a socially shared pattern of activity. Practices integrate material aspects such as tools, infrastructure, and technology, with the skills or knowledge necessary to carry them out, as well as socially and culturally constructed meanings that provide legitimacy and coherence to the practice. The ongoing interaction between these elements allows practices to be reproduced and modified through the involvement of actors. For example, cooking practices encompass the use of kitchen utensils (material), cooking skills (competence), and cultural values and norms related to food and its presentation (meaning).

Culinary skills are a central element in Practice Theory because they reflect not only technical proficiency in food preparation but also individual's level of confidence and competence to engage in cooking across diverse life situations. Empirical evidence suggests that adequate cooking skills contribute to greater individual responsibility for meal planning and preparation, which, in turn, affects diet quality and health outcomes (Murray et al., 2015). However, knowledge of nutrition or healthy eating does not automatically translate into daily practice without adequate skills, confidence, and contextual conditions (Murray et al., 2015).

From a Practice Theory perspective, **culinary knowledge** is understood as embodied and procedural, extending beyond mere recipe understanding or formal rules. This knowledge enables individuals to adapt cooking practices to the material and social

conditions they encounter. Torkkeli et al. (2018) describe cooking practices through a triangular model linking understanding (knowledge), procedures (skills), and engagement (meaning). This model suggests that procedural skills bridge the relationship between materials and competence, engagement connects competence with meaning, and understanding links meaning to materials in everyday culinary practices.

Materials are another important component of food consumption Practice Theory. These elements include food ingredients, kitchen utensils, and cooking technologies, as well as broader food infrastructure such as distribution systems, markets, and supporting technologies that enable or constrain cooking and consumption activities (Pilcher, 2016). The availability and access to these materials, along with the cultural meanings attached to them, shape individual participation patterns in culinary practices and determine the benefits derived from the food system.

Meaning refers to the social and cultural dimensions attached to food and cooking activities, including values, norms, traditions, ethical considerations, and emotional expressions. For example, fast food consumption is often morally positioned as a less-than-ideal choice, but in a family context, it can function as a form of care and time management, reflecting the complexity of cultural meanings in food choices (Meah & Jackson, 2017). Similarly, the context of culinary tourism demonstrates how the interplay between prior knowledge and cultural meanings influences individuals' engagement with local food experiences (Prayag et al., 2020).

1.5 Household Production/Consumption Theory

Household Production/Consumption Theory is an economic framework that explains how households utilize resources, including time, labor, money, and materials, to 'produce' goods or services that enhance the well-being of family members. Originally proposed by Gary Becker (1965), this theory emphasizes that households are not merely passive consumers but also act as producers within the domestic context. In practice, households allocate inputs such as financial resources to purchase food ingredients or kitchen equipment, time and labor to prepare and manage meals, and knowledge or skills in cooking and food planning. These inputs are transformed into outputs, including ready-to-eat or nutritionally balanced meals, efficient food management to prevent waste, and overall improvement in household welfare. The theory highlights the principle of efficiency, in which households aim to maximize the benefits from their available resources

at minimal cost. In the context of food consumption management, sociodemographic factors such as the presence of children, household size, and financial awareness affect how resources are allocated, whereas personal factors, including culinary competence, meal planning knowledge, and available infrastructure, serve as key inputs that facilitate the production of effective food consumption management. Efficiently managed outputs can reduce food waste and contribute to sustainability. Consequently, Household Production/Consumption Theory conceptualizes households as integrated production and consumption units that transform internal and external resources to achieve specific goals, such as fulfilling nutritional requirements, maintaining food quality, and minimizing food waste.

Within this framework, household activities encompass a series of interconnected practices, from food procurement and production to food preparation and consumption, and from food waste to waste management. Decisions at each stage are influenced by various considerations, including nutritional adequacy, food safety, cost efficiency, and environmental implications. Thus, food consumption behavior and waste management are not understood as separate actions but rather as outcomes of complex, interdependent household production-consumption processes (Damerau et al., 2020; Hellwig et al., 2022).

1.6 Responsible Production and Consumption

Responsible production and consumption are fundamental pillars of sustainable development, aiming to enhance resource efficiency, minimize waste, and promote sustainable practices across production systems and consumption patterns to safeguard long-term ecological integrity and economic resilience. Within this framework, responsible production refers to the systematic integration of sustainability principles into manufacturing processes and business operations, including preventive environmental initiatives and effective process management. Empirical studies demonstrate that such practices influence customer attitudes, employee behavior, and overall firm performance, and their financial and operational implications have been increasingly examined, particularly in developing country contexts (Liu et al., 2021).

At the organizational and supply chain level, environmental collaboration among actors, including suppliers, customers, and logistics providers, plays a crucial mediating role in translating responsible production and consumption practices into improved business performance. Sustainability-oriented strategies have been shown to enhance the

effectiveness of inter-organizational collaboration, underscoring the interconnected and relational nature of environmental initiatives across supply chains (Mishra et al., 2022). In sector-specific contexts such as energy, firms that adopt eco-efficient production practices and align operational strategies with environmental policies are better positioned to achieve sustainable growth through technological innovation and low-pollution processes, highlighting the strategic value of embedding sustainability within core business models (Bălăceanu et al., 2025).

From the consumer level, sustainable practices are deeply embedded within cultural norms and institutional arrangements, suggesting that incremental efficiency gains alone are insufficient to achieve meaningful change. The literature in this chapter emphasizes that sustainable consumption requires comprehensive systemic transformations encompassing technological, behavioral, and structural dimensions across key domains, including transportation, housing, energy use, and food consumption. These transformations extend beyond technological decoupling toward broader socio-technical system change (O'Rourke & Lollo, 2015).

In urban context, higher education institutions have been identified as influential actors in shaping sustainable consumption patterns, particularly among younger generations. By integrating environmental responsibility into everyday lifestyle choices, universities can help develop sustainable cities. However, empirical evidence indicates that engagement remains limited, especially in food production and consumption practices, suggesting significant untapped potential to foster environmentally responsible citizenship (Schoolman et al., 2014).

At the regional level, European Union member states have demonstrated measurable progress toward sustainable production and consumption in alignment with Sustainable Development Goal 12 (SDG 12) Responsible Consumption and Production. Despite this progress, persistent economic, social, and regional disparities continue to constrain implementation. Consequently, the literature highlights the importance of stronger policy integration and enhanced collaboration among stakeholders to overcome these barriers and support the EU's transition toward a climate-neutral economy by 2050 (Firoiu et al., 2025).

1.7 Circular Economy

The circular economy is a transformative economic model that aims to drive sustainable growth by fundamentally changing resource management and value creation. Conceptually, the circular economy can be defined as a systemic economic model focused on eliminating waste and pollution, circulating products and materials at their highest utility level, and regenerating natural systems, with the goal of supporting sustainable business growth and resilience through innovation along the value chain and stakeholder collaboration. This systemic approach demands innovation not only at the production stage, but also throughout the product lifecycle and overall business operations, to generate sustainable environmental, economic, and social benefits (Antikainen & Valkokari, 2016; Bansal et al., 2020; Velenturf & Purnell, 2021).

Unlike conventional linear economic models based on a take-make-dispose pattern, the circular economy focuses on reducing waste, maintaining materials within a sustainable cycle of use, and regenerating natural systems. This approach emphasizes the efficient use and reuse of resources throughout business processes, with the goal of closing material loops, reducing environmental impacts, while simultaneously increasing economic competitiveness and job creation.

A key characteristic of the circular economy is the need for systemic, and in many cases, radical innovation across business models and supply chains. To mainstream sustainable practices, companies are encouraged to adopt strategies such as durable product design, ease of repair and maintenance, product reuse and redistribution, and material recycling and recovery to maintain the value of resources for as long as possible within the economic system (Antikainen & Valkokari, 2016; Lüdeke-Freund et al., 2018). From the business sustainability perspective, the circular economy represents an integrative approach that simultaneously addresses environmental, social, and economic dimensions across various organizational processes. Its successful implementation relies heavily on stakeholder engagement, cross-actor collaboration, and the use of innovative measurement and evaluation tools to embed circular principles effectively in daily business practices (Bansal et al., 2020). Besides its focus on efficiency and technological innovation, the circular economy is also grounded in sustainable development values that emphasize environmental and social responsibility. Within this framework, the circular economy is positioned not only as a strategy for achieving economic benefits but also as an approach to reducing human pressure on natural resources and ecosystems. Therefore, the

implementation of circular practices must be carefully designed and evaluated to avoid unintended social and environmental impacts, which can arise from partial or uncoordinated implementation (Velenturf & Purnell, 2021).

The transformation towards a circular economy is facilitated through the development of circular economy business models (CEBMs), which orient business operations toward sustainability through business model innovation. CEBMs involve systemic changes to the product lifecycle, supply chain, and stakeholder network, with the goal of maintaining resources at their highest utility level for as long as possible (Bocken et al., 2019; Antikainen & Valkokari, 2016). In practice, the circular economy encourages various forms of innovation, including designing products and services that support reuse, repair, refurbishment, remanufacturing, and recycling; extending product life cycles and closing material loops; integrating sustainability impacts into business strategies and operations; and engaging and coordinating stakeholders within the business ecosystem. The use of digital technology also plays a crucial role in accelerating business model innovation and increasing the efficiency of resource flows (Antikainen & Valkokari, 2016; Ranta et al., 2020; Santa-Maria et al., 2021).

The circular economy is characterized by a systemic and holistic approach, a strong emphasis on innovation, both incremental and radical, and an orientation toward creating positive environmental and social impacts. The implementation of this model requires a transition from linear to circular practices, supported by frameworks, instruments, and policies that facilitate business model innovation and comprehensive sustainability assessment (Antikainen & Valkokari, 2016; Bocken et al., 2019; Bhatnagar et al., 2022; Munonye, 2025). The concept of the circular economy is highly relevant to addressing food waste because it offers a transformative approach that positions food waste not as a burden but as a valuable resource. This approach emphasizes increasing resource efficiency by closing material loops at various stages of the food system, including reducing, reusing, and recycling food waste, to minimize environmental impacts and promote sustainability.

In the context of the circular bioeconomy, special attention is paid to managing food waste by converting it into renewable food resources. This approach utilizes innovative and sustainable technologies, such as microbial fermentation and various biotechnological processes, to process underutilized food waste streams, for example, bread and jackfruit waste. This reduces food waste while generating additional economic value and environmental benefits (Pal et al., 2024). This transformation process contributes to the

development of a food system that is close to zero waste and reduces the environmental pressures imposed by the conventional linear 'take-make-dispose' model of food production and consumption.

From the consumption perspective, implementing the circular economy also requires social and behavioral changes. Studies on household food waste reduction practices indicate that changes in daily consumption patterns are a key factor in supporting the transition to the circular economy. Ethical values and moral responsibility embedded in consumption practices play a crucial role in successfully reducing household food waste. When supported by adequate policies and institutions, these consumer actions can shape a more circular food consumption system by preventing waste from its inception (Lehtokunnas et al., 2020).

In this context, the integration of circular economy principles is increasingly recognized as a vital strategy to enhance agri-food system sustainability and reduce food waste. Food waste is a substantial contributor to environmental degradation, accounting for approximately 16% of food system-related greenhouse gas emissions in Europe alone. Practices such as overproduction and the disposal of high-impact food products, particularly meat, further intensify the food system's carbon footprint. Circular economy models address these challenges by promoting waste prevention and valorization, including the conversion of food waste into value-added bioproducts. By closing material loops and reducing reliance on linear 'take–make–dispose' models, circular economy approaches directly support the objectives of SDG 12 and contribute to more sustainable patterns of production and consumption (Islam & Zheng, 2024; Dhiman et al., 2025

1.8 Economic Behavior

Economic behavior can be understood as a series of decision-making processes carried out by individuals, groups, or other entities in allocating limited resources to meet various needs and desires. This process encompasses how economic agents acquire and process information, formulate plans, and execute economic actions, influenced by a combination of subjective and objective factors over a specific time period. Therefore, economic decision-making is not solely based on the assumption of perfect rationality as emphasized in classical economic theory, but is also influenced by cognitive limitations, prior experience, behavioral preferences, and the social and cultural context that shapes how individuals interpret the economic situations they face.

From the behavioral economics perspective, economic behavior is viewed as a far more complex phenomenon that often deviates from the assumption of homo economicus, which is assumed to be completely rational and oriented toward optimizing utility. Individuals often exhibit behavioral patterns that deviate from the predictions of neoclassical economic theory due to limited information, subjective judgment, and limited cognitive ability to process choices, a concept known as bounded rationality. In addition, various psychological factors such as dynamic preferences, behavioral rules, the existence of competing goals as well as social and cultural influences shape the economic behavior of individuals and groups (Day, 1971; Hoff & Stiglitz, 2016).

Furthermore, when economic decision-making occurs in a group context, the mechanisms and outcomes of these decisions can differ significantly from those of individual decision-making. Social interaction and group dynamics can mitigate some of the individuals' biases and cognitive limitations, enabling groups to often make decisions that more closely align with the predictions of game theory and the standard framework of economic rationality. Conversely, individual decision-making tends to be more susceptible to cognitive biases and less influenced by rational social considerations (Charness & Sutter, 2012; Kocher & Sutter, 2007).

Behavioral economics encompasses the decision-making process related to resource utilization, involving both rational and non-rational elements and influenced by psychological, social, and cultural factors. This emphasizes that economics, as a behavioral science, continues to evolve by integrating insights from psychology and other social sciences to better understand and model the actual behavior of economic actors. Thus, economic behavior not only reflects rational choices that maximize profit, but also reflects the complexity and human context in the face of uncertainty and limited information (Day, 1971; Hoff & Stiglitz, 2016; Charness & Sutter, 2012). In behavioral economics, one aspect that also deserves attention is nudges. Nudges are a key concept in behavioral economics designed to subtly influence individual or group decision-making without being coercive, so that freedom of choice remains entirely with the decision-maker. This concept stems from the understanding that individuals have cognitive limitations and are strongly influenced by the decision-making context. Therefore, carefully designed interventions through choice architecture can help individuals make better decisions without diminishing their autonomy.

The link between nudges and behavioral economics is very close, as nudging leverages empirical understanding of how individuals actually behave, which is often not

entirely rational, to facilitate more effective decisions within existing cognitive and social constraints. In this context, economic behavior is influenced not only by rational considerations but also by changing preferences, past experiences, behavioral rules, and the social and cultural environment. Nudges work by adjusting the decision-making context so that individuals are encouraged to choose options that are more economically, socially, and health-beneficial, without feeling coerced or losing control over their choices (Day, 1971; Hoff & Stiglitz, 2016).

Several studies have shown that nudging strategies, such as providing information, reminders, and leveraging social norms, are effective in reducing food waste at the consumer level. For example, a field experiment at a star-rated hotel showed that posting simple informational messages at the breakfast buffet reduced the amount of food guests discarded. These messages function as informational nudges that help bridge the gap between awareness of food waste issues and actual behavior to reduce food waste (Schäufele-Elbers et al., 2024).

Furthermore, a systematic review found that nudges combining social norms and reminders were more effective at changing household food waste management behavior than interventions that focused solely on providing information about the environmental impacts of food waste. These findings underscore the importance of the social dimension in strengthening the effectiveness of nudging and demonstrate that sustainable behavior change requires more than simply increasing environmental knowledge (Barker et al., 2021).

2. Conceptual Framework

2.1 Food waste in Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) constitute a comprehensive global framework adopted by the United Nations, comprising of 17 goals (Fig. 1) and 169 targets designed to address interconnected global challenges, including poverty, inequality, health, education, gender equality, and environmental sustainability. As a universal development agenda, the SDGs guide collective action toward a more sustainable future by emphasizing the interdependence and indivisibility of the social, economic, and environmental dimensions of development.

Source: https://sdgs.un.org/goals

Figure 1. The 17 Sustainable Development Goals

Within this framework, Sustainable Development Goal 12 (SDG 12) specifically addresses the need to ensure responsible consumption and production patterns. A central component of SDG 12 is Target 12.3, which explicitly focuses on reducing food loss and waste. This target aims to halve per capita global food waste at the retail and consumer levels, while simultaneously reducing food losses along production and supply chains, including post-harvest losses, by 2030. As such, food waste reduction is positioned as a critical lever for achieving more sustainable consumption and production systems globally.

Food waste represents a major sustainability challenge because it entails not only a loss of economic value but also substantial, avoidable environmental pressures. These include excessive greenhouse gas emissions, inefficient use of land and water resources, and unnecessary energy consumption throughout the food system. As approximately 1.05 billion tons of food are wasted worldwide each year, with households, retail outlets, and food service establishments accounting for the largest share of this waste (Dhiman et al., 2025; Islam & Zheng, 2024), addressing food waste is essential for mitigating environmental impacts and improving the overall efficiency of food systems.

Among various stages of the food supply chain, consumer behavior plays a particularly significant role, as more than half of global food waste is generated at the household level. Empirical evidence demonstrates that changes in lifestyle and consumption patterns can substantially influence the magnitude of food waste. For instance, during the COVID-19 pandemic in Italy, shifts in household routines and food purchasing behavior led to the increase in domestic food waste, despite the temporary closure of restaurants and other food service outlets. Studies using food diary methods further suggest that improved time management, a healthier work–life balance, and the use of smart food delivery and planning strategies can help reduce household food waste. These behavioral adjustments closely align with the economic, social, and environmental objectives of SDG 12 (Amicarelli & Bux, 2020).

2.2 Sustainable Food System

A sustainable food system (SFS) is a comprehensive framework designed to ensure food security and adequate nutrition for every individual while safeguarding the economic, social, and environmental pillars that sustain them for future generations. It embraces a holistic perspective encompassing the entire food system, including environmental factors, human actors, inputs, processes, infrastructure, and institutions. In addition, the goal of a sustainable food system is to ensure long-term food and nutrition security, encompassing access, utilization, availability, and stability of food at global, national, and local levels (Bilali et al., 2018). A key element of a sustainable food system is integrating diverse strategies, such as improving efficiency, promoting sustainable diets, and transforming food systems to be more inclusive of alternative approaches. An efficient system involves not only production processes but also consumption practices to minimize environmental impacts. For example, precision agriculture and climate-

smart farming practices are increasingly encouraged to boost productivity while maintaining ecological integrity in the face of climate challenges (Singh & Singh, 2017). Technology plays a crucial role in the sustainable food system framework, with artificial intelligence (AI) and information and communication technology (ICT) contributing to process optimization. These technologies enhance productivity, improve resource efficiency, and support the transition toward sustainable food systems by integrating systemic approaches and strengthening resilience to socio-economic and environmental changes (Abdallah et al., 2024; Serbulova et al., 2019). One notable shift in consumption patterns is the growing adoption of plant-based diets, which can reduce environmental impacts while improving food and nutrition security (Berry, 2019). Building a food system that accounts for multiple dimensions, such as health, socio-economic factors, and ecological conservation is considered essential for creating a sustainable food system. This approach extends to all stages of the food cycle, from production and processing to distribution, preparation, and consumption, considering the socio-economic and environmental ramifications.

At its core, a sustainable food system operates on the principle that the well-being of both current and future generations depends on responsible resource management and equitable distribution of benefits across the food chain. Economic resilience is a fundamental component of sustainable food systems. This necessitates the adaptation of agricultural practices to ensure the financial viability of farmers and stakeholders. Such adaptation includes innovations, such as artificial intelligence, to enhance efficiency in food production and supply chains (Çakmakçı et al., 2023; Abdallah et al., 2024). This means ensuring that food production practices are environmentally sustainable, minimizing waste and pollution, conserving natural resources, and promoting biodiversity. It also entails fostering social equity and inclusivity, ensuring that all individuals have access to nutritious food, regardless of socioeconomic status or geographic location.

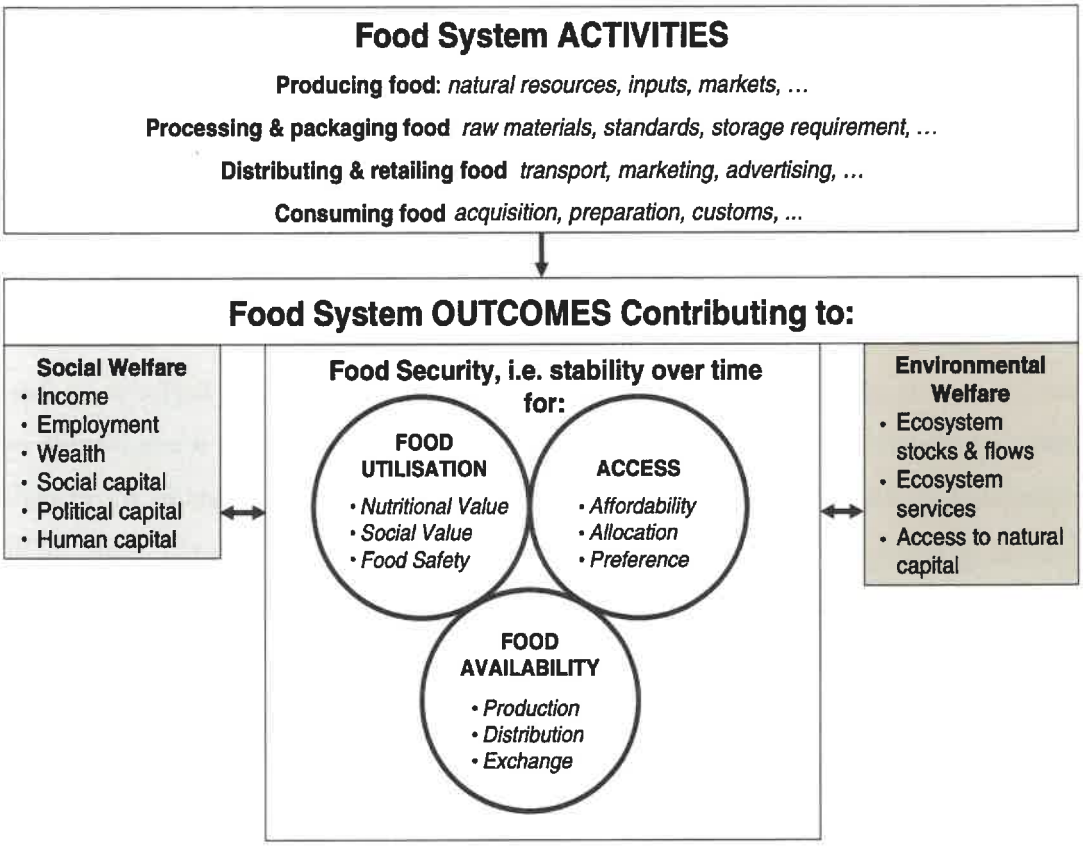
The concept of a sustainable food system recognizes the interconnectedness of various stakeholders and sectors within the food system, emphasizing the importance of collaboration and collective action in addressing complex challenges, such as food insecurity, malnutrition, and environmental degradation. The interaction between food security and the broader sustainability transition is highly significant, as highlighted by existing research. Ensuring food and nutrition security requires efforts that transcend sectoral boundaries and promote cross-sectoral collaboration to effectively address food insecurity and malnutrition (Kiba et al., 2023; Bilali, 2019). Effective strategies must integrate

both centralized and decentralized systems, as illustrated by the challenges faced by smallholder farmers in the Caribbean, where adaptive and diverse institutional frameworks are essential to foster innovation and sustainability (Ville et al., 2015). The intersection of food security and mental health further underscores the need for comprehensive strategies that incorporate mental well-being into food security solutions. Success stories from Ghana and Canada, along with innovations such as the European Union's 'Farm to Fork Strategy,' demonstrate the potential of collective and integrated approaches (Onyeaka et al., 2024). Moreover, addressing gender gaps through the empowerment of women in agriculture is fundamental to achieving sustainable food systems and responding to climate change (Naheed & Rukhsana, 2024). Integrating underutilized legumes into farming systems offers a sustainable solution to enhance food security and nutrition while providing environmental benefits. However, their potential remains untapped due to socio-economic and market barriers. Overcoming these challenges requires policy reforms and the promotion of international cooperation for knowledge and technology exchange (Vilakazi et al., 2025).

Furthermore, understanding the drivers of food insecurity and their impacts on ecosystems is crucial. Strategies such as climate-smart agriculture and payments for ecosystem services can mitigate negative impacts and promote sustainable agricultural production (Aryee et al., 2024). Technology also plays a pivotal role across the food production-consumption chain, supporting efforts to increase food output and reduce waste, thereby contributing directly to achieving zero hunger (Grewal et al., 2024). Ultimately, advancing sustainable food systems depends on collaborative, cross-disciplinary approaches that integrate social justice, environmental sustainability, and innovative technologies to effectively address complex global challenges.

The transformative changes required to achieve a sustainable food system encompass technological innovation, policy reform, and shifts in consumption patterns (Cook et al., 2021; Alam et al., 2025; Polyportis et al., 2024). At the local level, this could mean encouraging regenerative agricultural practices and strengthening local food supply chains. On a national scale, governments can implement policies that support sustainable food production and reduce food waste. Globally, international cooperation is needed to address challenges such as climate change and food access inequality. This transformation requires the active participation of all parties, including farmers, consumers, companies, and policymakers, to create a food system that not only meets current needs but also ensures food security for future generations. Transformative change towards a

sustainable food system requires a holistic approach encompassing multiple dimensions. Technological innovation plays a vital role in improving production efficiency and reducing environmental impact, such as through the use of precision agriculture and alternative food technologies (Mclennon et al., 2021). Shifts in consumption patterns are also crucial, involving consumer education on more sustainable food choices and reducing household food waste. Implementing such changes requires actions at various levels. Locally, focusing on regenerative agriculture can help restore soil health and increase biodiversity, while strengthening local supply chains reduces the carbon footprint and enhances community food resilience. Nationally, governments can play a crucial role by implementing policies that support sustainable practices, such as subsidies for organic farming or regulations limiting the use of harmful pesticides (Czyżewski et al., 2020; Yerkinbayeva et al., 2024). International cooperation is essential for addressing global challenges such as climate change and unequal food access, which necessitate cross-border coordination and the exchange of knowledge and resources. This comprehensive transformation demands commitment and collective action from all stakeholders, from farmers to policymakers, to create a resilient, fair, and sustainable food system for present and future generations. Eventually, the journey toward a sustainable food system is an ongoing process that requires adaptation, innovation, and sustained commitment to ensure fairer, more efficient, and environmentally friendly approaches to food production and consumption. This shapes the holistic perspective, encompassing the food supply chain from farm to fork. By addressing these interconnected challenges, we can build a future where nutritious food is accessible to all while preserving the planet's resources for future generations.



Source: Ingram, 2011, p. 421.

Figure 2. Sustainable Food System

The basic model identified in Figure 2 was further developed by the Global Environmental Change and Food Systems (GECAFS) program (GECAFS, 2005) to illustrate the interactions among drivers and feedbacks. This includes not only the major activities and outcomes involved in food systems but also the critical processes and factors that influence the social and environmental outcomes that are part of a food system. As depicted in Figure 1, the food system comprises six primary activities, commencing with storage and progressing through packaging, processing, retailing, consumption, and ultimately disposal. Each of these activities has the potential to generate waste. Waste generated during the packaging and processing stages is referred to as food loss, whereas waste occurring during retailing and consumption is termed food waste. Both food loss and food waste have a significant impact on food security (Ingram, 2011). Recognizing and addressing these issues across the entire food system is crucial for ensuring sustainable food production and consumption practices.

Food security, as defined by the 1996 World Food Summit and frequently cited, is an essential goal for society. It involves ensuring that every person consistently has access to sufficient, safe, and nutritious food, taking into account physical, economic, and social factors. This access should allow them to fulfil their dietary needs and preferences, supporting an active and healthy lifestyle (FAO, 1996; FAO et al., 2012). Research from China highlights a substantial degree of food loss and waste (FLW), which is increasingly affecting food security and environmental sustainability. The results of this study reveal a notable FLW of 422.56 million metric tons, or roughly 22.37% of the global food supply. This study also revealed important environmental consequences, such as estimates of the land footprint, water footprint, and carbon footprint. These effects are most noticeable in foods such as fruits, vegetables, cereals, and animal products. They can occur at any point in the food supply chain, from consumption to agricultural production, post-harvest processing, and storage (Jia et al., 2023).

Food waste management is crucial for achieving global sustainable food security. A new concept, Food Quality Loss or Waste (FQLW), has been proposed to address the loss of nutritional characteristics along the food chain (Santeramo & Lamonaca, 2021; Wani et al., 2024). Pedrotti et al. (2023) stated that food waste occurs at the urban supply chain level, particularly among mobile vendors and households living below the poverty line (Pedrotti et al., 2023). The largest share of food waste is generated at the household level, with over 40% occurring in European countries (Campoy-Muñoz et al., 2017). Household food waste is a significant issue that impacts sustainable food systems worldwide. Research indicates that a significant portion of food waste is avoidable, with a substantial amount occurring during food preparation (Barker et al., 2023;Fazreena et al., 2022). Factors influencing food waste generation include household consumption patterns, with a focus on reducing waste through strategies such as sharing extra food, planned purchases, and understanding family preferences (Niluh et al., 2022). In addition, household food waste often arises from reaching expiry dates, preparing more food than necessary, and aesthetic considerations (Mokrane et al., 2022).

2.3 Sustainable Household Food Waste Management

Sustainable household food waste management is crucial for environmental and economic reasons. Research shows that a significant amount of food waste is generated at the household level, contributing to greenhouse gas emissions and other forms of

waste. Sustainability must address food security, environmental impacts, and economic outcomes in line with the Sustainable Development Goals (SDGs), as households contribute significantly to food waste through inefficient food management (Scalvedi & Rossi, 2021). Effective strategies for reducing food waste include proper meal planning, mindful shopping behaviors, and diligent waste separation, with an emphasis on recycling and composting organic waste. Innovative initiatives, such as vermicomposting, can transform organic waste into valuable resources, such as vermicompost, thereby mitigating the environmental impact of waste disposal. Furthermore, legislation and policies, such as Malaysia's SWPCM Act 2007, play vital roles in promoting sustainable waste management practices. These regulations emphasize the 3Rs (reduce, reuse, recycle) to minimize waste generation and maximize resource recovery (NH Nordin et al., 2020; Mak TMW et. al., 2020; Slorach et al., 2020; Haldar et. al., 2022). This concept emphasizes waste reduction at the production stage, the reuse of materials to extend their life cycles, and the recycling of waste into usable raw materials, thereby preventing resource depletion and mitigating greenhouse gas emissions. In the context of household food waste, the practical implementation of the 3Rs primarily involves minimizing food waste, reusing leftovers or surplus food, and recycling organic waste through composting or similar practices. Implementing sustainable practices, such as the 3R principles, can reduce unmanaged waste and promote a more sustainable food system in urban areas (Niluh et al., 2015).

Reducing food waste involves purchasing only necessary quantities, engaging in effective meal planning, applying proper food storage practices to extend shelf life, and managing unavoidable food waste through composting. This preventive approach minimizes the likelihood of excess food spoiling and being discarded. Reuse practices include the creative utilization of leftovers or surplus food, such as transforming them into new meals, stocks, or animal feed. Recycling refers to the processing of food waste into compost or bioenergy, thereby diverting organic materials from landfills and supporting circular resource use. These practices align with sustainability principles by enabling the reuse of natural resources in environmentally responsible ways (Albizzati et al., 2021; Srivastava et al., 2022; Singh et al., 2024). The implementation of the 3Rs in household food waste management promotes sustainable consumption patterns, enhances food security, and reduces environmental pressures while conserving resources. Achieving these outcomes requires behavioral changes at the consumer level, including mindful purchasing, cooking, and waste disposal practices guided by the principles of Reduce, Reuse,

and Recycle. Integrating reuse and recycling strategies not only mitigates the environmental impacts of waste disposal but also creates economic opportunities by promoting sustainable practices across food supply chains and waste management sectors (Sarangi et al., 2024; Albizzati et al., 2021).

The priority scheme in food waste sustainability is based on three pillars:

(a) economic impact, which can be positive, benefiting the economy from waste management, or negative, increasing the economic costs of waste disposal;

(b) environmental impact, which is generally negative (e.g., greenhouse gas emissions) but can also be positive (e.g., utilization of waste to remove pollutants from wastewater); and

(c) social considerations, which can be positive (e.g., redistribution of food to those in need) or negative (e.g., increased taxes) (Garcia et. al., 2017).

Each pillar encompasses both beneficial and adverse dimensions that shape overall sustainability outcomes. The economic pillar examines both the benefits and costs of food waste management. On the one hand, efficient waste management practices can create economic value by generating revenue through waste utilization and resource recovery, thereby supporting economic development. On the other hand, food waste imposes substantial economic burdens, including collection, transportation, and disposal costs. Empirical evidence suggests that global food waste results in economic losses exceeding one trillion dollars annually. These findings highlight the need for economically optimized supply chain strategies to reduce losses while enhancing operational efficiency and profitability (Urugo et al., 2024; Arowosegbe et al., 2024).

Food waste predominantly generates negative environmental impacts, particularly through its contribution to greenhouse gas emissions, land degradation, water scarcity, and energy inefficiency. These effects have been extensively examined within the frameworks of environmental sustainability and life cycle assessment, highlighting food waste as a critical factor undermining the sustainability of food production and consumption systems. Nevertheless, from the perspectives of the circular economy and the circular bioeconomy, food waste also offers opportunities for environmental benefits when managed effectively. For instance, biotechnological approaches can repurpose food waste to remove pollutants from wastewater or produce renewable bioproducts such as bioenergy and biofertilizers. Such practices exemplify circular economy principles that prioritize closing material loops and maximizing resource value, thereby transforming food waste from an environmental liability into a valuable resource. Consequently,

circular bioeconomy based food waste management contributes to reducing the ecological footprint of food systems and supports the transition toward long-term environmental sustainability (Urugo et al., 2024; Pal et al., 2024).

Social considerations in food waste management relate to its effects on societal well-being, encompassing both positive and negative outcomes, and represent a fundamental component of the triple bottom line sustainability framework. On the positive side, redistributing surplus food to vulnerable populations helps alleviate food insecurity while fostering social equity, reflecting principles of social justice in sustainability. Food donations to charitable organizations are a prominent policy strategy that simultaneously addresses food waste reduction and community needs. Conversely, social impacts may also be adverse, such as the imposition of additional taxes or regulatory costs to fund food waste management initiatives. Other challenges include insufficient legislation, weak organizational governance, and consumer behaviors that demonstrate limited awareness of waste impacts, all of which contribute to food waste generation. Accordingly, well-designed and targeted social interventions are essential to ensure that food waste management delivers fair and sustainable outcomes while supporting the development of a more inclusive and socially responsible food system (Urugo et al., 2024; Canali et al., 2016; Eriksson et al., 2020). In the triple bottom line framework, social considerations in household food waste management go beyond reducing waste to include ethical responsibility, equitable resource sharing, and the engagement of all household members in decision-making. This perspective emphasizes that families and individuals should not only consider economic savings and environmental impacts but also reflect on how their food practices, such as meal planning, portioning, and redistribution of surplus food, affect community well-being, social equity, and human welfare (Nica et al., 2025; Loviscek, 2021).

Furthermore, social considerations in food waste management are closely linked to broader sustainable development objectives, including the Sustainable Development Goals (SDGs), which aim to eradicate hunger, ensure food security, improve health outcomes, reduce inequalities, and promote sustainable consumption and production patterns. The connection between food waste and food insecurity underscores the importance of food recovery and redistribution programs in alleviating hunger and enhancing community well-being, with government policies playing a pivotal role in supporting these initiatives. By incorporating social indicators such as community access to food, employment opportunities generated through food recovery programs, and levels of social acceptance into food

waste management strategies, assessments can be conducted in a more comprehensive manner, consistent with the integrative principles of the triple bottom line framework (Anwar & El-Bassiouny, 2019; Loviscek, 2021; Kalogiannidis et al., 2025).

2.4 Food Consumption Management

Sustainable food waste management depends on behavioral changes at the consumer level. Interventions aimed at reducing household food waste typically focus on enhancing meal planning, improving management routines, and shaping consumption behaviors. Although various behavior change strategies have been implemented and evaluated internationally, consistent evidence of their long-term effectiveness remains limited. Food consumption management is a holistic process encompassing meal planning, food preparation, storage, consumption, and serving. Effective meal planning involves determining the appropriate types and quantities of food needed to meet nutritional requirements, within budget constraints, and in line with individual preferences.

Food preparation refers to the processes that transform raw ingredients into edible, and in some cases shelf-stable foods through methods such as cooking, canning, drying, or freezing. Alongside proper preparation, proper food storage is essential for maintaining food safety and quality, as it helps prevent spoilage and contamination by controlling temperature, humidity, and packaging conditions. Within household food management, food preparation and consumption encompass activities such as menu planning, managing raw materials and ingredients, ensuring efficient processing, and determining appropriate portion sizes. These practices aim to safeguard food safety, preserve nutritional value, maintain food quality, and support healthy eating patterns. Portion management, in particular, plays a critical role in aligning food intake with household needs while reducing unnecessary leftovers and waste. In relation to food waste, effective food preparation significantly reduces household waste. Careful planning and efficient use of food resources help households avoid over-purchasing, maximize the use of available ingredients, and minimize food waste from spoilage or expiration. Studies reveal that implementing behavior-based strategies, such as visual cues and organized meal planning, significantly reduce the waste of fresh vegetables and fruits and overall food waste (Boulet & Lauren, 2024). A lack of knowledge regarding food edibility and proper storage contributes to household food waste; however, this can be mitigated through the development of food preservation skills and planned purchasing behavior. Households that

understand how to extend food freshness, align purchasing decisions with actual needs, and manage leftovers effectively are more successful in reducing food waste (Teng et al., 2021). Conversely, poorly organized or inefficient food preparation can increase food waste, especially when ingredients are not fully used or meals are prepared in excessive quantities. Therefore, food preparation is a key component of household food management, contributing to reducing food waste and promoting more sustainable food consumption practices. Household food waste often arises from interconnected everyday practices, including meal planning, grocery shopping, and food storage. Enhancing these routines through more efficient food preparation and storage practices can help reduce unintended food waste. In addition, domestic infrastructures and storage-related technologies influence how these practices are carried out, underscoring that effective food preparation also involves the use of appropriate tools and storage solutions (Dobernig & Schanes, 2019).

Food processing is a central component of food consumption management and is closely associated with food waste generation. Food consumption management comprises a range of interconnected activities, including meal planning, purchasing, storage, preparation, and consumption, all of which are shaped by the level and type of food processing involved. Inefficient or inappropriate practices in food processing and consumption management can lead to increased food waste, both at the household level and across the broader food supply chain. The influence of food processing on food waste is largely mediated through differences in product durability and shelf life. Foods that undergo higher levels of processing generally have longer shelf lives, which can reduce spoilage-related waste compared to fresh or minimally processed foods that are more perishable and more likely to be discarded if not consumed in time. Nevertheless, food processing can also generate losses during manufacturing and distribution, thereby contributing to overall food waste within the food system. Empirical evidence indicates that consumers tend to waste fewer ultra-processed foods with extended shelf lives, whereas diets rich in fresh fruits and vegetables are often associated with higher levels of food waste due to their shorter shelf lives (Lisciani et al., 2024).

At the household level, food management routines, such as menu planning, pre-shopping inventory checks, and storage practices tailored to different levels of food processing, play a critical role in preventing food waste. These practices help extend product shelf life and reduce avoidable disposal. Moreover, individual motivation and social norms that emphasize sustainability encourage the adoption of more responsible food

management practices, thereby further reducing food waste (Ananda et al., 2023). Food literacy and consumer awareness of food processing and consumption are also key determinants of effective food waste management. Consumers with higher levels of food and nutrition literacy are generally better equipped to manage food purchasing, storage, and preparation efficiently, thereby minimizing waste. Educational interventions aimed at enhancing food literacy have been shown to support improved management of both processed and unprocessed foods, while simultaneously promoting healthier and more sustainable consumption patterns (Lisciani et al., 2024).

Beyond individual knowledge and skills, environmental awareness and conscious consumption behaviors further shape food waste outcomes. Environmentally aware consumers are more likely to engage in practices such as cooking at home, carefully planning food purchases, and avoiding impulse buying, all of which are associated with lower levels of food waste. In contrast, frequent eating out and impulsive purchasing behaviors are positively correlated with increased food waste. These findings highlight the importance of consumption habits shaped by food processing levels and consumption contexts in determining household food waste (Chen, 2019). At a systemic level, the food processing industry also contributes to environmental pressures through water consumption and wastewater generation, linking food waste to broader sustainability challenges. The adoption of sustainable food processing practices, including innovations in water management and waste valorization, can mitigate environmental impacts and support circular economy objectives by reducing waste outputs and improving resource efficiency (Asgharnejad et al., 2021; Bux & Amicarelli, 2022). The relationship between food processing, food consumption management, and food waste is multifaceted. The degree of processing affects product perishability and waste-generation patterns, while consumer behavior in managing processed foods, guided by literacy, environmental awareness, and routine practices, significantly impacts household food waste. Sustainable practices at both the consumer and industry levels offer opportunities to reduce food waste in food processing and consumption management.

Food consumption pertains to the actual intake of food, taking into account hygienic handling, portion control, and adherence to a balanced diet. Lastly, serving food involves presentation, portioning, and ensuring that meals remain safe and appealing until consumed. Generally, these processes are critical for optimizing nutritional intake, reducing food waste, and supporting overall food security and health outcomes (Capone et al., 2014; Adeyeye, 2017; Thompson & Amoroso, 2014). Food consumption and

serving practices play a critical role in both generating and preventing food waste, which constitutes a significant social and environmental challenge. Consumer behaviors during food purchasing, preparation, serving, and consumption directly determine the volume of food discarded at both household and foodservice levels. A central factor influencing food waste is the method of presentation and portioning. For instance, buffet-style dining frequently generates greater waste, as consumers tend to serve themselves more than they ultimately consume. However, integrating buffet services with moral or financial incentives such as discounts for finishing meals has been shown to effectively reduce waste (Chang, 2021). Accordingly, careful attention to presentation strategies and the motivational context of consumers is essential for mitigating post-serving waste. From the consumer perspective, environmental consciousness and awareness of food waste encourage preventive behaviors, such as deliberate food purchasing, meal planning, and home cooking, whereas impulsive buying and frequent dining out are associated with higher levels of food waste (Chen, 2019). Thus, consumption patterns encompassing both meal frequency and setting mediate the relationship between food consumption practices and waste generation. Adopting a healthy lifestyle and consuming meals at home further contribute to waste reduction. While individuals who consume more fresh fruits and vegetables may generate greater quantities of perishable waste, overall, a nutritious diet combined with waste-prevention practices leads to lower net household food waste (Savelli et al., 2019). This underscores the nuanced relationship between diet quality and food waste, highlighting the importance of education in food literacy and proper storage techniques. Food and nutrition literacy is particularly significant. Enhanced knowledge enables consumers to optimize food shopping, storage, and cooking practices, and to adjust portion sizes to minimize waste. Socioeconomic factors also play a role, for example, lower-income individuals generally discard less food compared to wealthier consumers (Lisciani et al., 2024). Cultural norms further shape waste-reduction behaviors. In Japan, the concept of mottainai, which conveys regret over wasting valuable resources, promotes sustainable practices across meal planning, preparation, consumption, and surplus management, thereby reducing food waste (Sirola et al., 2019).

Reducing food waste at the consumption and serving stages requires a multifaceted approach, including fostering environmental awareness, promoting healthy consumption habits, enhancing food literacy, implementing thoughtful presentation and portioning strategies, respecting cultural values, and enacting policy interventions that incentivize responsible behavior. Collectively, these measures improve food utilization efficiency,

alleviate environmental pressures, and strengthen food security by minimizing food loss (Chen, 2019; Chang, 2021; Savelli et al., 2019; Lisciani et al., 2024; Sirola et al., 2019).

Recent studies highlight the need for replicable, longitudinal interventions that foster sustainable household habits to reduce food waste, thereby enabling meaningful reductions in waste at a larger scale. The household food waste journey is the process of food waste from (1) planning, (2) in-store, (3) pre-consumption, (4) consumption, and (5) disposal. Each stage functions as an interconnected element within the household food system, collectively constituting the structural and behavioral mechanisms through which food waste is produced and potentially mitigated. A theoretically grounded understanding of the roles, interactions, and feedback relationships among these stages is therefore fundamental to developing integrated and sustainable approaches to reducing household food waste.

Household food consumption management emphasizes the efficient use of food through careful planning, storage, and consumption practices. Strategic meal planning and portion control can reduce over purchasing and minimize waste, while proper inventory management and storage practices maintain food quality, extend shelf life, and prevent spoilage. Additionally, consumer knowledge of labeling and expiration dates plays a critical role in guiding food consumption decisions, ultimately influencing household waste generation (Scalvedi & Rossi, 2021; Liegeard & Manning, 2019).

Behavioral factors, conceptualized through frameworks such as the Theory of Planned Behavior (TPB) and the Value-Attitude-Behavior (VAB) model, further elucidate the psychological and social determinants of household food waste. TPB posits that attitudes, perceived behavioral control, and social norms shape intentions and actions related to waste reduction, with greater motivation and perceived control fostering better planning and storage behaviors. Similarly, the VAB model highlights how core values influence attitudes toward waste minimization, which, in turn, guide actual consumer behavior (Hatab et al., 2021; Habib et al., 2023; Ananda et al., 2023).

Sustainable food waste management encompasses strategies for prevention, recovery, and recycling to mitigate environmental, social, and economic impacts. Prevention focuses on improving consumption management through behavioral interventions, including environmental awareness and education. Recovery redirects edible food to those in need, while recycling, such as composting, reduces contributions to landfills. Emerging technological innovations, such as smart packaging and IoT-enabled kitchen appliances, offer opportunities to enhance inventory control and provide real-time

information on food quality, supporting waste reduction throughout the household food journey (Liegeard & Manning, 2019; Cammarelle et al., 2021).

Moreover, socioeconomic and cultural factors, including household power dynamics, perceptions of what constitutes food or waste, and access to resources and knowledge, shape the variability of waste behaviors and the effectiveness of reduction strategies across populations (Soma, 2017). A theory-informed understanding of the household food waste journey underscores the importance of effective consumption management through planning, storage, and consumer awareness. An integrated approach that incorporates behavioral theory, household routines, sociocultural context, and technological innovations is essential for achieving sustainable reductions in household food waste (Scalvedi & Rossi, 2021; Hatab et al., 2021; Ananda et al., 2023; Liegeard & Manning, 2019).

2.5 Socio-demographic factors of food waste

The journey of food waste from its creation to disposal involves a range of practices shaped by cultural, organizational, and individual factors. Understanding these practices is essential for developing effective strategies to mitigate food waste (Daniel, 2015; Noore et al., 2019; Ludovica, 2018). Effective household food consumption management has been shown to reduce food waste, particularly in urban households in developing countries such as India (Bhatia & Sharma, 2023). Raising awareness and enhancing knowledge of best practices in meal planning, storage, and portion control are critical for preventing waste in rapidly urbanizing populations. Barker et al. (2023) highlight that waste reduction is most pronounced in households with one, three, or four or more members and in households where at least one member has a university degree, demonstrating the role of education and knowledge in shaping consumption practices. Household characteristics, including size, income, and education levels consistently influence food waste patterns. Research in China (Wraith, 2022) and India (Bhatia & Sharma, 2023) indicates that these factors significantly affect waste generation. In Nigeria, male-led households and urban settings exhibited higher levels of food waste than rural or female-led households (Sunday et al., 2022). Similarly, studies in Ethiopia identified attitudes, perceived behavioral control, knowledge of food waste impacts, and sociodemographic traits as significant predictors of household food waste among urban residents (Paul & Sánchez, 2023). Research in Toronto suggests that household size and the presence of children

negatively correlate with per capita food waste, implying that children indirectly influence waste through practices related to the management of perishable items (Li et al., 2021). Additionally, sociodemographic characteristics and food-shopping routines are key determinants of household food waste behavior, emphasizing that personal factors and contextual conditions interact to shape waste patterns in urban, developing settings (Hatab et al., 2021).

Similarly, studies conducted in Europe indicate diverse yet significant relationships between sociodemographic factors and household food waste. For instance, in Denmark and Spain, older age and unemployment are associated with lower levels of food waste, whereas male gender is associated with higher levels of food waste in Denmark. Notably, larger households tend to generate less food waste per capita, highlighting the complex relationship between household size and waste production (Grasso et al., 2019). In Germany, perishable foods are the most frequently discarded items, and household size, life cycle stage, and the presence of children influence the amount of waste, although sociodemographic factors overall show limited predictive power (Herzberg et al., 2020).

Advanced modelling approaches applied to European Union data reveal that country of residence, respondent age, student status, and perceptions of family food waste significantly affect reported waste levels. However, there is limited evidence of urban-rural or gender differences, and the effect of income varies across countries. These findings suggest that sociodemographic factors interact with cultural and contextual factors to shape household food waste patterns (Grainger et al., 2018). Machine learning analyses further identify household size, presence of picky eaters, employment status, and home ownership as key drivers of food waste, indicating that larger households represent critical targets for intervention (Grainger et al., 2018). Although household size frequently influences food waste, with larger households sometimes generating less per capita, other factors such as income, education, attitudes, knowledge, and behavioral control also play significant roles. Cultural and regional variations further modulate these effects, underscoring the need for context-specific approaches to effectively reduce household food waste (Hatab et al., 2021; Grasso et al., 2019; Herzberg et al., 2020; Grainger et al., 2018). Household size can have dual effects, larger households may generate more waste overall, but they often implement more effective strategies to manage food consumption and minimize waste (Zhang et al., 2020; Li et al., 2021). Income and education levels also shape food waste behaviors. While wealthier and more educated households have greater resources to manage food efficiently, higher purchasing capacity can

paradoxically lead to increased waste (Fami et al., 2019; Cheng et al., 2022). Other factors, including age, gender, lifestyle, and food shopping behaviors, further influence urban household food waste (Santana et al., 2017; Hoang et al., 2020; Smith & Landry, 2021).

On the other hand, the presence of children in household food consumption management significantly influences both food waste generation and the adoption of sustainable food management practices, though these effects are complex and shaped by multiple factors. Research indicates that parental care and the desire to provide abundant food, often reinforced by the presence of children, can paradoxically increase food waste. Caregivers may stockpile favorite foods or purchase in large quantities to demonstrate attention and ensure availability, which can lead to excessive waste due to overbuying or spoilage (Porpino et al., 2016). Thus, while caregiving motivations promote food abundance that benefits children, they may inadvertently undermine efforts to reduce food waste unless carefully managed. Feeding practices also reflect children's dietary patterns, which are indirectly linked to household food waste management. Restrictive or pressuring feeding strategies have been associated with suboptimal consumption, lower nutrient intake, and higher caloric density, potentially disrupting eating behaviors and influencing how food is consumed or discarded (Loth, 2016). Conversely, authoritative and structured feeding practices foster healthier eating habits and greater self-regulation among children, supporting more sustainable food consumption behaviors (Peters et al., 2012; Frankel et al., 2017).

The presence of children also shapes family meal organization, affecting both consumption and waste patterns. Longer, structured family meals are associated with higher fruit and vegetable intake and reduced food waste among children (Burg et al., 2021; Frankel et al., 2017). Moreover, caregivers' feeding styles influence children's eating behaviors, which in turn impact overall household food waste, highlighting the importance of the social context of feeding (Hughes et al., 2007). Parental awareness and nutritional knowledge, when combined with positive feeding practices, promote healthy dietary intake among children and can indirectly enhance household food management and reduce waste (Peters et al., 2012). Nevertheless, poorly managed food abundance and inadequate meal planning remain persistent challenges in households with children, underscoring the need for targeted interventions that leverage behavioral economics and environmental messaging to encourage sustainable practices (Porpino et al., 2016; Bretter et al., 2023). Children's presence in the household simultaneously presents challenges

and opportunities for sustainable food waste management. Positive feeding practices and structured mealtime environments tend to reduce waste, whereas well-intentioned efforts to provide abundant food may inadvertently increase it. These dynamics underscore the need for balanced, informed household food management strategies that address both children's needs and sustainability objectives. Attitudes toward food waste, shaped by both understanding and perceptions of wasting food, play a critical role in determining the volume of food discarded. Intergenerational differences are also evident, with younger individuals often wasting more food due to limited skills in shopping, storing, and cooking leftovers (Karunasena et al., 2021; Hezberg et al., 2020). Gender remains a critical determinant; in Nigeria and Lebanon, male-led households, often larger or owned solely by men, are associated with higher levels of household food waste (Sunday et al., 2022; Paul & Sanchez, 2022). Older consumers generally demonstrate higher awareness of food waste issues and are more likely to engage in environmentally responsible purchasing and consumption practices (Chen, 2019). This pattern indicates a positive association between age and food waste prevention behaviors. Such behaviors include more aware food planning, home-based food preparation, and the efficient use of purchased food, which are more prevalent among older demographic groups and contribute to reduced food waste.

In contrast, younger consumers, while often expressing strong sustainability awareness, particularly among Generation Z and Millennials, exhibit greater variability in sustainable consumption behaviors. These behaviors are strongly shaped by lifestyle dynamics, time constraints, and belief systems, which can limit the consistent translation of environmental awareness into effective food waste reduction practices (Agustina et al., 2024). In practice, the adoption of food waste reduction behaviors varies significantly and is influenced by contextual factors such as lifestyle patterns, time availability for food preparation, and underlying belief systems (Melnyk et al., 2025; Islam, 2020). Research conducted in German university students found that while intentions to reduce food waste are shaped by pro-environmental knowledge and attitudes, translating these intentions into actual behavior is highly dependent on moderating factors, including levels of environmental awareness (Melnyk et al., 2025). Similar findings were observed among Korean university students, demonstrating a significant gap between awareness and practice in food waste reduction, highlighting the importance of targeted educational interventions (Islam, 2020). Young consumers often face various structural barriers, such as time constraints and fast-paced lifestyles, that limit their ability to consistently adopt

food waste reduction behaviors despite their high awareness and values for sustainability (Chen, 2019). Furthermore, concerns about food safety, including the risk of foodborne illness and a preference for freshness, have increasingly influenced food storage and consumption practices among younger adults (Qi & Roe, 2016; Abbott et al., 2007). In contrast, older consumers tend to exhibit more stable and consistent patterns of food waste prevention behavior. These differences suggest that while younger generations possess strong environmental awareness, their adoption of food waste reduction practices remains influenced by practical constraints and varying belief systems. Therefore, to increase the effectiveness of food waste reduction across demographic groups, tailored interventions are needed, particularly educational initiatives that consider the needs, barriers, and life contexts of younger consumers (Fraj-Andrés et al., 2022). Significant differences were observed between younger and older consumers in their food waste reduction behaviors, therefore, age is incorporated as a key determinant in this study. Moreover, financial awareness emerges as a key driver of food waste reduction, complementing lifestyle- and belief-related factors by encouraging more deliberate and resource-efficient food management practices.

Financial awareness is an important aspect of household food consumption management and of reducing food waste. Consumers who are more financially aware tend to implement more systematic purchasing planning, avoid impulsive buying, and manage food storage and utilization more efficiently, thereby reducing food waste. Economic considerations play a key role in food waste reduction behavior, as wasted food is perceived as a tangible loss of resources and monetary value. Furthermore, financial constraints can encourage more reflective consumption patterns and more sustainable food management practices, with an emphasis on saving and optimizing the use of available resources (Amicarelli et al., 2021). Financial awareness promotes more systematic food purchasing planning, discourages impulse buying, and enhances the efficiency of food storage and utilization, thereby contributing to minimizing food waste. The substantial economic losses associated with food waste further reinforce financial considerations as a key behavioral driver, encouraging more sustainable and resource-efficient consumption patterns. Within this framework, households emerge as central actors in food waste reduction efforts through the adoption of more rational and responsible consumption practices (Attiq et al., 2021; Hermanussen et al., 2022; Katare et al., 2019)

2.6 Economic Implications of Food Waste

Food waste not only signifies the discarding of economic resources essential for sustaining the production cycle but also imposes significant global economic burdens. Annually, the cost of food waste and loss (FWL) amounts to a staggering USD 1 trillion worldwide, rising to approximately USD 2.6 trillion when environmental and social impacts are considered (UNO, 2024). In European countries, food waste and loss FWL costs reach approximately EUR 131 billion annually (Eurostat, 2021). Recognizing the significant economic toll of FWL underscores the critical need for concerted measures to reduce food waste and loss across all levels of the supply chain, thereby encouraging economic prosperity and environmental sustainability. The economic implications of managing household food waste are a major concern, as efficient handling methods can reduce economic strain on society and alleviate environmental constraints (Lusk & Ellison, 2020). In the European context, various studies show no consistent relationship between gross domestic product (GDP) per capita and the amount of food waste per capita. This finding underscores the complexity of the economic factors underlying food waste and suggests that improving the efficiency of the food supply chain and interventions targeting consumer behavior play a more crucial role in promoting sustainable consumption patterns (Gencia & Balan, 2024). At the micro level, research on Italian consumers reveals an inverted U-shaped relationship between income and food waste, particularly for higher-value food products. Low- to middle-income households tend to purchase lower-quality food products in larger quantities, ultimately contributing to higher food waste. Furthermore, greater wastage among low-income groups has the potential to exacerbate economic inequality, particularly through the wastage of certain types of food. This suggests that food waste behavior is influenced not only by income levels but also by economic inequality and consumer purchasing patterns (Setti et al., 2016). Furthermore, economic modeling evidence confirms that reducing household food waste can yield simultaneous economic and environmental benefits. Reducing food waste increases household savings while reducing the need for agricultural food production, thereby reducing pressure on land use and greenhouse gas emissions. Although the macroeconomic impact of these changes is relatively limited, their aggregate benefits to food security and environmental sustainability are considered significant (Philippidis et al., 2019).

Food waste is mostly determined by behavioral factors, such as meal planning and attitudes toward expiration dates, as well as by economic factors, such as household size

and food expenditure (Fami et al., 2019; Hatab et al., 2021). However, the complex dynamics of food waste are influenced by several factors, including consumer preferences, food safety issues, and government regulations. Therefore, enhancing waste management practices is not the only method used to reduce food waste. It also requires addressing fundamental economic behavior and incentives (Cheng et al., 2022).

2.7 Household Competencies and Skills, Material Infrastructure, and Knowledge of Composting Practices

Practice Theory, encompassing the elements of material, meaning, and competence, provides a robust theoretical framework for understanding and promoting sustainable household food waste management (Scalvedi & Rossi, 2021; Shove et al., 2012). The household food waste journey, which includes the stages of planning, purchasing, preparing, consuming, and disposing of food, aligns with Practice Theory, as it allows food waste behavior to be analyzed as a sequence of interconnected social practices (Principato, 2017). The study by Principato integrates the household food waste journey with Practice Theory to examine how material, meaning, and competence collectively influence sustainable food management.

Within this framework, competence, including culinary skills, menu planning, food storage, waste management, and composting, is essential because it directly affects the effectiveness of food management at each stage of the household food waste journey (Keegan & Breadsell, 2021). Routines shaped by competence and experience, and influenced by motivation and social norms, have been shown to improve food planning and storage behaviors, thereby reducing waste (Ananda et al., 2023). In addition to competence, material elements such as the availability of storage facilities, kitchen equipment, and packaging innovations are crucial in shaping household food management practices. Technologies like active and smart storage or packaging can extend food shelf life and provide real-time information on quality, supporting more efficient and sustainable consumption behaviors (Cammarelle et al., 2021). Furthermore, knowledge of composting practices is assumed to be related to household food waste management. Studies show that increased awareness and knowledge alone do not necessarily translate into positive waste management behaviors without the proper infrastructure and enabling conditions (Massoud et al., 2021). For instance, a study in a Swedish municipality found that

Phycological Factors	Social Factors	Situational Factors	Demographics and SES variables
- Attitudes - Perceived behavioral control - Food waste knowledge - Food waste Involvement - Habits, emotions	- Social norm	- Level of urbanization - Perception of the amount of litter	- Age - Level of education - Household composition

→ **Wasteful Behavior**

Household Food Waste Journey				
Planning	**In-store**	**Pre-consumption**	**Consumption**	**Disposition**
		Storage		
- Lack of planning - Lack of shopping list - Lack of meal planning	- Impulsive purchases - Presence of children - Marketing strategies - Visual merchandise strategies	- Sub-optimal storage - Misinterpretation of expiration dates - Food freshness fear - Food safety fear - Lack of sensory skill	- Leftovers - Lack of proper storage of leftovers - Food preferences	- Do not separate kitchen waste
		Preparation		
		- Sub-optimal culinary skill - Cooking for serving too much food - Inability to cook leftover into new meals		

Sources: Principato (2017)

Figure 3. The household food waste journey model to understand wasteful behaviour

household waste behaviors were shaped not only by economic incentives but also by residents' attitudes toward the perceived difficulty of recycling and composting, highlighting the importance of personal skills and the willingness to devote time when supportive infrastructure is available (Bartelings & Sterner, 1999). The availability of easily accessible composting sites and the assurance that segregated waste will be properly managed after collection are the infrastructure incentives that most strongly encourage community participation in composting and waste sorting (Widyatmika & Bolia, 2023).

In many low- and middle-income countries, limited facilities and infrastructure are major barriers to the adoption of sustainable waste management practices (Massoud et al., 2021). A similar situation exists in rural areas of developing countries, where local governments face challenges due to limited budgets and inadequate equipment, highlighting the importance of collaborative solutions between households and local authorities to improve waste management (Viljoen et al., 2021). In the context of household composting practices, composting has been recognized as a sustainable strategy for managing organic waste, reducing urban waste volume, and generating economic and environmental benefits, particularly when supported by local governments through financial assistance and environmental awareness programs (Sulewski et al., 2021). However, effective composting faces challenges, including contamination risks from per- and polyfluoroalkyl compounds (PFAS), which can impact human health and ecosystems, necessitating the application of innovative remediation technologies (Biek et al., 2024). Furthermore, there remains a knowledge gap regarding the factors contributing to contaminant accumulation during composting, underscoring the need for further education and research to ensure the quality and safety of compost products (Biek et al., 2024). From the meaning element, reflecting how food practices are socially and culturally interpreted, further influences motivations throughout the household food waste journey. Norms, values, and beliefs shape decisions during planning, purchasing, preparation, and consumption, determining whether households adopt sustainable food management practices.

Integrating the household food waste journey with theories of practice through the interplay of material, meaning, and competence and knowledge provides an effective analytical framework for understanding food waste dynamics and designing more targeted interventions. Increasing household competence, providing adequate material resources, and reinforcing positive meanings about sustainable consumption collectively have the potential to improve food waste management across all stages of the household food waste journey (Scalvedi & Rossi, 2021; Ananda et al., 2023; Cammarelle et al., 2021; Keegan & Breadsell, 2021).

In dining contexts beyond the household, the professional expertise of kitchen staff in managing surplus food underscores the critical roles of knowledge, attitudes, and skills, with attitudes particularly pivotal (Ko & Lu, 2020). For example, Taiwanese hospitality students emphasize the importance of personal moral stance, food-handling attitudes, and culinary knowledge in surplus food management, demonstrating a strong foundation in ethical considerations and practical competencies (Ko & Lu, 2022). Similarly,

the implementation of sensory evaluation techniques in culinary education in Denmark underscores the importance of sensory knowledge and skills in creating appealing, sustainable food, potentially reducing waste by encouraging the adoption of healthy, sustainable options (Damsbo-Svendsen et al., 2022).

A holistic approach to culinary education incorporating creativity and innovation further strengthens students' capacity to manage food resources effectively (Hu et al., 2016). Competency skills, such as decision-making and the ability to refuse undesirable practices, are pivotal in fostering good food management behaviors, including waste reduction, by mitigating negative practices (Epstein et al., 2007). Evidence also indicates that undergraduates with higher culinary skills consume higher-quality diets, highlighting the role of culinary confidence in promoting healthier eating and potentially reducing food waste (Pelonha et al., 2023). Moreover, training food scientists and technicians in food storage, infrastructure, product development, and communication is crucial for advancing practical solutions to minimize waste (Flynn et al., 2013). The relationship between cooking skills, nutritional quality, and the food environment suggests that individuals with stronger culinary competencies rely less on convenience foods, further contributing to waste reduction through home cooking (Siddiqui et al., 2023). Enhancing professionals' competencies for food system transformation requires integrating intuitive, participatory, and integrative research and innovation methodologies into culinary education to address broader sustainability goals (Boer et al., 2021). In addition to competency, material contexts, including infrastructure and technology, shape food shopping and storage behaviors. Advancements in food retail infrastructure, housing layouts, and storage technologies influence consumer practices and can reduce food waste (Diana et al., 2022; Dobernig & Schanes, 2022). Research suggests that innovative containers and appliances improve storage behavior and minimize waste by increasing transparency and consumer awareness of food safety and shelf life (Liegeard & Manning, 2020; Lusk & Ellison, 2020). Collectively, these findings demonstrate that integrating competence, material resources, and meaningful educational approaches in professional and educational settings is essential for promoting effective food management and sustainable practices that reduce food waste across the broader food system.

2.8 Cultural and religious context for food waste in urban areas

Urban areas are characterized by several fundamental attributes. First, they are marked by significant population size, social diversity, and population density, all of which contribute to the formation of a distinct urban ethos and lifestyle (Wirth, 2020). Additionally, urban areas are characterized by public spaces with functional programs, human-scale development, identifiable features, and various architectural styles (Gyurkovich, 2015). The economic dynamics of modern cities, including robust market economies, legal frameworks that support rights and citizenship, and a commitment to diversity and openness, are paramount in shaping urbanism (Zhu & Hong, 2018). Moreover, the cultural landscape of urban centers reflects regional, ethnic, and cultural nuances, exerting a profound influence on residents and visitors alike (Xue Yun, 2005). Most inhabitants of urban areas have non-agricultural jobs.

Food waste in urban areas represents a significant global challenge (Bhatia et al., 2023; Liu et al., 2023; Pedrotti et al., 2023; Wong et al., 2023). Studies have shown that urban context exacerbates food waste issues due to higher consumption and disposal rates. Urban food waste is an urgent issue affecting both developed and developing nations worldwide. Research indicates that food waste is a problem in urban low- and middle-income countries (LMIC), affecting households, retail stores, and food service establishments, among other levels (Bhatia & Sharma, 2023; Sahoo et al., 2023). Food waste production differs significantly between urban and rural households, with urban households generating much more waste because of various dietary habits and behaviors, according to a study conducted in Harbin, China (Rejman and Jeżewska-Zychowicz, 2023). In the wake of recent events such as COVID-19, controlling food waste in urban environments involves a complex network of formal and informal actors.

According to studies, urban context is associated with dietary shifts, with urban areas consuming more animal protein and simple carbohydrates, whereas rural areas continue to eat traditional foods (Chalak et al., 2019). The link between healthy lifestyles and food waste intensity is clear, with healthy food choices and eating at home being associated with reduced food waste (Savelli et al., 2019). Urban households waste significant amounts of food, with Lebanon reporting approximately 0.2 kg per capita per day, which contains essential elements such as calories, protein, and vitamins. The urbanization process in Burkina Faso is also linked to a move toward Western diets, which

offer a wider range of foods, including processed options. This dietary shift is accompanied by lifestyle changes (Casari et al., 2022).

Furthermore, studies have revealed that household food shopping behavior influences food waste, with online grocery shopping linked to greater food waste, especially in the fruit and vegetable categories (Yenerall & Chen, 2023). For instance, the use of technology, such as mobile apps like Foodscover, is a promising way to reduce food waste in the retail industry. These apps provide a platform for selling surplus food at discounted rates, thus mitigating the shortcomings of existing strategies for reducing food waste in urban areas, such as Singapore (Jürgens, 2023). These insights highlight the importance of embracing innovative technologies and sustainable approaches to address the complexities of urban food waste. Secondi et al. (2019) advocate investing in digital technology innovation to preserve food surpluses and alleviate food waste.

The cultural context of urban environments significantly shapes household food-waste behaviors. Research indicates that urban households in developing countries exhibit diverse waste management practices, showing a tendency towards waste reduction, utilization, and composting (Bhatia & Sharma, 2023). Additionally, food waste governance in urban areas involves a complex interplay among formal institutions, informal livelihood strategies, and external factors such as the COVID-19 pandemic, necessitating a reassessment of food production and consumption dynamics (Karani et al., 2021; Soma & Warshawsky, 2022). In Romania, urban households also contribute to food waste, influenced by the cultural dynamics prevalent in urban areas, with consumption patterns being a significant factor (Dumitru et al., 2021). Furthermore, individual behavioral traits, such as attitudes, perceived control over behavior, knowledge of the impacts of food waste, and sociodemographic factors, contribute to food waste behaviors in urban settings of developing countries (Bishnoi et al., 2022; Paul & Sánchez, 2022). Recognizing these cultural nuances is imperative for devising effective interventions to foster sustainable food consumption habits and curb household food waste in urban areas.

Religion significantly influence food waste practices in urban households, as well as other aspects of household finances (Cwynar et al., 2024). Studies from China and Nigeria indicate that religious rural households waste less food than non-religious households do (Qian et al., 2022; Bhatia & Sharma, 2023; Aleshaiwi, 2023). In Saudi Arabia, moral and spiritual principles lead hosts to manage excess food during household parties, directing it to charity rather than trash (Sobaih, 2023). These findings highlight the need

to incorporate religious and moral beliefs, as well as behavioral therapies, to effectively address food waste in urban households.

Urban areas in Indonesia addressing food waste issues integrated religions and morals into their practices. Religion plays a significant role in shaping ethical behaviors and decisions regarding food consumption and waste management (Arli and Pekerti, 2016). The approach to minimizing food waste is consistent with the religions, ethics, and moral principles of the people of Indonesia. This integration is a component of future sustainable environmental responsibility, incorporating religion and ethics to address excessive food surplus waste (Kusumaningtiar et al., 2023; Singagerda et al., 2024).

2.9 Food waste among young consumers and the early stage of family

Young consumers play a crucial role in household food waste, which has ethical, environmental, and economic implications. Research suggests that despite expressing concern for the environment, young consumers often fail to implement effective food waste reduction practices, resulting in an attitude-behavior gap. This discrepancy is particularly notable in high-income countries, where factors such as special occasions, food quality assessment, kitchen habits, and shopping behaviors influence food waste among young consumers (Clement et al. 2023). Studies have shown that young people's interest in food waste issues can influence their attitudes and behaviors toward reducing food waste. However, misconceptions, such as attributing the primary responsibility for food waste to the foodservice and retail sectors, hinder effective action due to a lack of accurate information (Rejman & Jeżewska-Zychowicz, 2023). Surveys conducted among young adults in Poznań revealed challenges in purchasing appropriate food quantities and a tendency to prepare excessively large portions, indicating the necessity for targeted educational initiatives (Zieba, 2022). Similarly, research in Slovakia underscores the importance of understanding consumer perceptions and behaviors to mitigate food waste at the household level (Husárová 2022). Food sharing among young consumers demonstrates a positive attitude toward reducing food waste, with gender playing a significant role in shaping these attitudes (Wiśniewska & Czernyszewicz, 2022). In Romania, distinct consumer typologies based on food waste behavior have been identified, including 'young wasters' and 'conscious non-wasters', underscoring the need for tailored interventions (Pocol et al., 2023). Generational disparities also contribute to food waste, with younger generations wasting more food due to a lack of food management skills

(Karunasena et al., 2021). Studies conducted in Pakistan have revealed that cognitive and emotional factors significantly influence young consumers' behavior regarding food waste reduction (Attiq et al., 2021).

Family development theory provides a framework for understanding the progression of a family over time, delineating the various stages and transitions that it encounters. Within this theoretical framework, a early stage of family occupies a pivotal position, typically marked by the expansion of the family unit through childbirth or the initial years of child rearing. In this stage, parents struggle with the complexities of taking on parental responsibilities while protecting themselves from external community needs (Rago, 2016). Evelyn Duvall's model of family development outlines a series of stages that most families go through, from the beginning of a marriage to the death of one of the spouses. This paradigm, as described in the provided contexts, defines eight distinct stages:

(1) married couple without children,

(2) childbearing families with the oldest child between birth and 30 months,

(3) families with preschool children,

(4) families with school-age children,

(5) families with adolescent children,

(6) launching families where the first to the last child is leaving home,

(7) middle-age families transitioning from "empty nest" to retirement, and

(8) aging families from retirement to the death of both spouses (Arri et al., 2019).

There are diverse perspectives through which one can perceive a the early stage of family, capturing the array of family compositions, associated difficulties, and interplay of societal and individual factors. Essentially, the early stage of family commonly denotes a family unit in the initial stages of its life cycle, typically comprising youthful parents and their first children. This period is characterized by notable changes, including adjustments to parental responsibilities and the incorporation of children into the family structure (Hidenko, 2022).

In Indonesia, the early stage of family life, often characterized by early marriage, is a multifaceted phenomenon influenced by legal, sociological, economic, and cultural factors. Legally, early marriage is defined by Act No. 1 of 1974, which permits marriage at the age of 19 for men and 16 for women. However, societal practices and pressures often lead to marriages at these ages or younger (Musrifah & Putri, 2022). Moreover, in Muslim countries, the expectation for a father to support his children after divorce, even

if they reside separately, is grounded in Islamic legal principles and cultural norms. This obligation is emphasized through the concept of maintenance (nafkah), which encompasses the father's duty to ensure his children's welfare by providing essentials such as food, clothing, and shelter (Asman & Ahmed, 2023). The legal structure within Islamic law, notably outlined in the Compilation of Islamic Law, stipulates that post-divorce, the father's responsibility towards his underage children persists, highlighting support provision as a paternal obligation (Hasibuan 2022).

3. Scope, objectives and research hypotheses

3.1 Scope of the Research

To clarify the scope of the study, it is necessary to provide operational definitions for the key terms used. These are:

Food waste: All types of food and beverages obtained for human consumption within households that are subsequently discarded through various disposal methods. Food waste includes both edible and inedible items.

Early stage of family: Young couples aged 19 to 39 in 2024 who are navigating the early stages of marriage and parenting. They reside together, with or without children, with the eldest child being under 12 years old, and are financially independent from extended family members living in the same household.

Urban area: A geographic area characterized by a population exceeding 1 000 000 inhabitants, high population density, and social diversity. These features contribute to a distinct urban context including religion, culture and way of life, with the majority of residents engaged in non-agricultural occupations.

Household: A household comprises individuals living together in a shared dwelling and sharing meals from a common kitchen. Typically, households consist of parents and their children. Boarding houses, dormitories, and other non-family living arrangements are excluded.

Respondent: An individual or entity that provides information in a research study or survey. In this study, respondents are usually a husband or wife who manages household income for both food and non-food expenses, makes daily purchasing decisions for the family, and is responsible for food preparation.

Thematic scope: This study focuses on understanding the determinants of household food waste management, with particular attention to socio-demographic characteristics, factors explained by Practice Theory, character of urban areas, and food consumption management practices. The thematic scope of this study is explained in detail in the following chapters defining its objectives, research questions, and hypotheses.

The spatial scope of the research embraces urban areas represented by Bogor City and Bogor Regency in Indonesia. Indonesia is Southeast Asia's largest contributor to food waste, producing 20.93 million tons annually (Food Waste Index, 2021). It is one of the most populous countries in the world, ranking fourth after India, China, and the United

States. The population reached approximately 285 million in 2025 and continues to grow steadily each year. The country is characterized by unique socio-demographic conditions, including rapid urbanization, uneven population distribution, and a relatively young population structure. More than half of the population resides in urban areas, and around 56% live on the island of Java despite its relatively small land area. Indonesia operates a mixed economy where the private sector and the government play significant roles. As the only G20 member state in Southeast Asia, it has the region's largest economy by GDP (ranking inside the top 20 in nominal terms and top 10 by purchasing power parity) and is classified as a newly industrialized country. Indonesia is home to around 600 distinct native ethnic groups. The Javanese, making up 40% of the population, are the largest ethnic group and the politically dominant one. Indonesia officially recognises six religions: Islam, Protestantism, Roman Catholicism, Hinduism, Buddhism, and Confucianism, while acknowledging religious freedom in the constitution. As of 2024, 87,1% of the population (244 million Indonesians) are Muslims, making Indonesia the world's most populous Muslim-majority country.

As the main aim of this study focuses on families in the early stages of marriage in **urban areas** of Indonesia, this research employed specific sampling criteria, focusing on areas with urban characteristics - the central urban area of Bogor City and extended to selected regions within Bogor Regency. The rationale behind selecting Bogor City and Bogor Regency stems from the characteristics of urban areas in Indonesia. Urban areas in Indonesia are generally areas with large populations, where the majority of available jobs are non-agricultural. They are additionally characterized by high population density, advanced infrastructure and public services, and their central roles in economic, educational, and governmental functions.

Bogor City, as a municipality, is officially classified as an urban area based on its administrative status. In contrast, Bogor Regency is administratively designated as a rural area. However, several districts within Bogor Regency, especially those located near Jakarta, are experiencing rapid and intensive urbanization. These areas exhibit urban characteristics and are increasingly categorized as peri-urban zones within the broader Jabodetabek (Jakarta-Bogor-Depok-Tangerang-Bekasi) megapolitan region (BPS, 2023). Bogor City and Regency are suitable for this research, as they have dense populations and more than 1 000 000 inhabitants that belong to the urban cities category (Indonesia Government Regulation No. 26 of 2008). The majority of jobs available In Bogor City and Bogor Regency are non-agricultural.

Bogor City is a landlocked city located in West Java, Indonesia, approximately 53 km south of the national capital, Jakarta. Bogor is the sixth-largest city within the Greater Jakarta metropolitan area and ranks fourteenth nationally in terms of population size. The city covers an area of 111,39 km². According to the national census, the population of Bogor city is 950 334 (in 2010), then the population of Bogor city is 1 078 351 (in 2025). It has increased significantly over the past 10 years.

Bogor serves as an important center for economic activities, scientific research, cultural heritage, and tourism in Indonesia. Notably, Bogor is home to the Presidential Palace and the Bogor Botanical Gardens (Kebun Raya Bogor), one of the oldest and largest botanical gardens in the world. Due to its high annual rainfall, the city is widely known as the 'Rainy City' (Kota Hujan), with frequent precipitation occurring even during the dry season. The central area of Bogor is characterized by extremely high population density, with several hundred thousand residents concentrated within approximately 20 km², making it one of the most densely populated urban centers globally. Rapid population growth since the 1960s has been closely associated with urbanization processes and the influx of labor migrants from other regions of Indonesia. Indonesia's crude birth rate has shown a consistent decline over the past decades. In mid-2025, the birth rate was estimated at 15.54 births per 1 000 population, representing a 1.39% decrease compared with mid-2024, when the rate reached 15.76 per 1 000 population. This pattern reflects a sustained downward trend that has continued for approximately fourteen consecutive years.

Demographically, males accounted for approximately 51% of the population, while females accounted for about 49%. In 2024, around 23.82% of residents were aged 0–14 years, 66.28% were within the working age group (15–59 years), and 9.9% were aged 60 years and above. Life expectancy in Bogor reached approximately 74.9 years in 2024, reflecting an improvement compared with earlier estimates and ranking among the highest in Indonesia. Religiously, Bogor's population is predominantly Muslim, accounting for approximately 93% of residents. Christians constitute around 6% of the population, alongside smaller Buddhist communities primarily within the Chinese population and Hindu communities. Despite the Muslim majority, the city hosts a substantial number of Christian churches and other religious institutions, reflecting its religious diversity.

Bogor Regency is located in the western and southwestern part of West Java Province, Indonesia. The administrative capital of the regency is Cibinong District. Geographically, Kabupaten Bogor is bordered by Lebak Regency (Banten Province) to the west;

Tangerang Regency, South Tangerang City, Depok City, Bekasi City, and Bekasi Regency to the north; Karawang Regency and a short boundary with Purwakarta Regency to the east; Cianjur Regency to the southeast; and Sukabumi Regency to the south. Bogor City constitutes an enclave within the administrative territory of Kabupaten Bogor and is located at its central area. Administratively, Bogor regency consists of 40 districts (kecamatan), which are further subdivided into villages (desa) and urban wards (kelurahan). According to data from the Bogor Regency Statistics Office (BPS) in 2021, the total population reached 5 427 068 residents, with an average population density of approximately 1 817 persons per km^2, reflecting the regency's high level of urbanization and demographic pressure. The indigenous population of Bogor regency, as well as West Java more broadly, is predominantly Sundanese. However, the regency is ethnically diverse due to migration and urban expansion, with substantial populations of Javanese and Betawi, as well as other ethnic groups such as Cirebonese, Batak, Chinese Indonesians, Minangkabau, Bantenese, and others.

In terms of religious composition, the population of Kabupaten Bogor is overwhelmingly Muslim. Based on data from the Ministry of Home Affairs in 2024, approximately 97,18% of residents adhere to Islam. The remaining population consists of Christians (2,32%), including Protestants (1,76%) and Catholics (0,56%), as well as smaller proportions of Buddhists (0,30%), Confucians (0,15%), and Hindus (0,05%). This religious landscape reflects both the strong Islamic tradition of the region and its pluralistic social structure.

According to the Central Bureau of Statistics Indonesia (BPS), in 2021, young people aged 20 to 45 made up the majority of the population, 64,94%, in both Bogor City and Bogor Regency. Thus, this spatial scope of the research not only captures a broader urban context encompassing urban areas but also ensures that the required sample size is adequately achieved.

The study population consists of households at the early stage of family life in Indonesia. Therefore, this study expands the age range of respondents from 18-40 years old to represent the previous shifts in the average age of marriage. The young families included in this research are defined as couples who meet the following criteria:

(1) one or both partners are above 18 years old and a maximum of 40 in 2024,

(2) they reside in the Bogor area,

(3) they share the same household (father, mother, and children),

(4) they have children, with the eldest child being no older than 12 years old (maximum in the stage of family with school-age children, referring to Duval's theory), and

(5) they are not financially dependent on their extended family members living in the same house.

These selection criteria ensured a focused study of couples at the early stages of family life in the specific urban context of Bogor, Indonesia. The participants in this study were heads of households responsible for managing domestic affairs, including financial oversight of both food and non-food expenditures, meal planning, food provision within the home, and food waste management. The food waste considered in this study included both edible and non-edible food. Furthermore, this study focused solely on intact nuclear families to prevent financial bias, thereby excluding single-parent and divorced families. In Muslim countries, divorced families with children require fathers to provide for their children's needs, even if they live in separate households (Pradipta et al., 2024).

Rationale behind the above-listed criteria stems from the legal and traditional attitude to marriage as well as from the theory of family development. The early stage of family, influenced by laws and customs, allows marriage at 19 for men and 16 for women under Act No. 1 of 1974. This period is characterized by young marriages and the growth of the family unit through childbirth and early child-rearing. The initial family stages of marriage, as referred to in Evelyn Duvall's theory of family development, encompass a series of evolving phases that reflect the changing dynamics within a family unit. These stages begin with the (1) 'married couple without children' phase, progressing to (2) 'childbearing families' where the oldest child is between birth and 30 months. As children grow, families enter the (3) 'families with preschool children' stage, followed by the (4) 'families with school-age children' phase. The progression continues with (5) 'families with adolescents,' which marks the challenges of the teenage years. Next, (6) 'launching families' experience the departure of children from the home, transitioning into (7) 'middle-age families,' characterized by an 'empty nest' period that extends into retirement. Finally, (8) "aging families" encompass the stage from retirement to the death of both spouses. Each stage presents unique challenges and transitions, reflecting the evolving nature of family life. For this research, there is a restriction on young families from the early stage of the family through the married-couple phase, until families with school-age children. It is representative of an early stage of family due to the age of

couples who are still struggling with social and economic problems. Moreover, the maximum age of the respondents in 2024 is 39 years. According to Hurlock (1980), it belongs to the early maturity stage. In addition, the interval of young families in this study aligns with the changing cultural trends in Indonesia, where many young people are increasingly less inclined to marry for various reasons. This shift is supported by data from the Indonesian Statistics Centre (2024), which shows that there were only 1,58 million married couples in 2023. This number represents a decrease of 7,51% or 128 000 couples from the 1,71 million married couples recorded in 2022.

Time scope of the research

This study comprises of several stages carried out over the 4-year time span. The study began with with a literature review, followed by the development of research questions and objectives. Subsequently, a hypothetical model was constructed. Next phases involved designing the research methodology for data collection, actual data collection in Indonesia, conducting data analysis, interpreting the results, and engaging in discussion, culminating in the writing of the dissertation. The literature review supporting the development of the model hypotheses began in October 2022 and was completed in June 2024. The collection of data was conducted from July till October 2024 in Indonesia. Thus, the findings reflect the latest trends in food waste at early-stage families in urban areas of Indonesia.

3.2 Objectives and Research Questions

Addressing the identified knowledge gap, the **main objective** of this study is to provide a better understanding of the relationships between the selected socio-demographic characteristics (presence of child, age, household size, financial awareness), urban context (competency and culinary skill, knowledge of food planning and composting, material and proper infrastructure), food consumption management practices (healthy life style, grocery shopping online, culture of food sharing, religion), and sustainable household food waste management during the early stage of family life in urban areas of Indonesia using modelling.

This study aims to minimize financial bias and provide insights into food waste behavior within this specific demographic group in urban Indonesia. This approach allows for a more controlled analysis of how family dynamics, resource allocation, and household management strategies influence food waste practices.

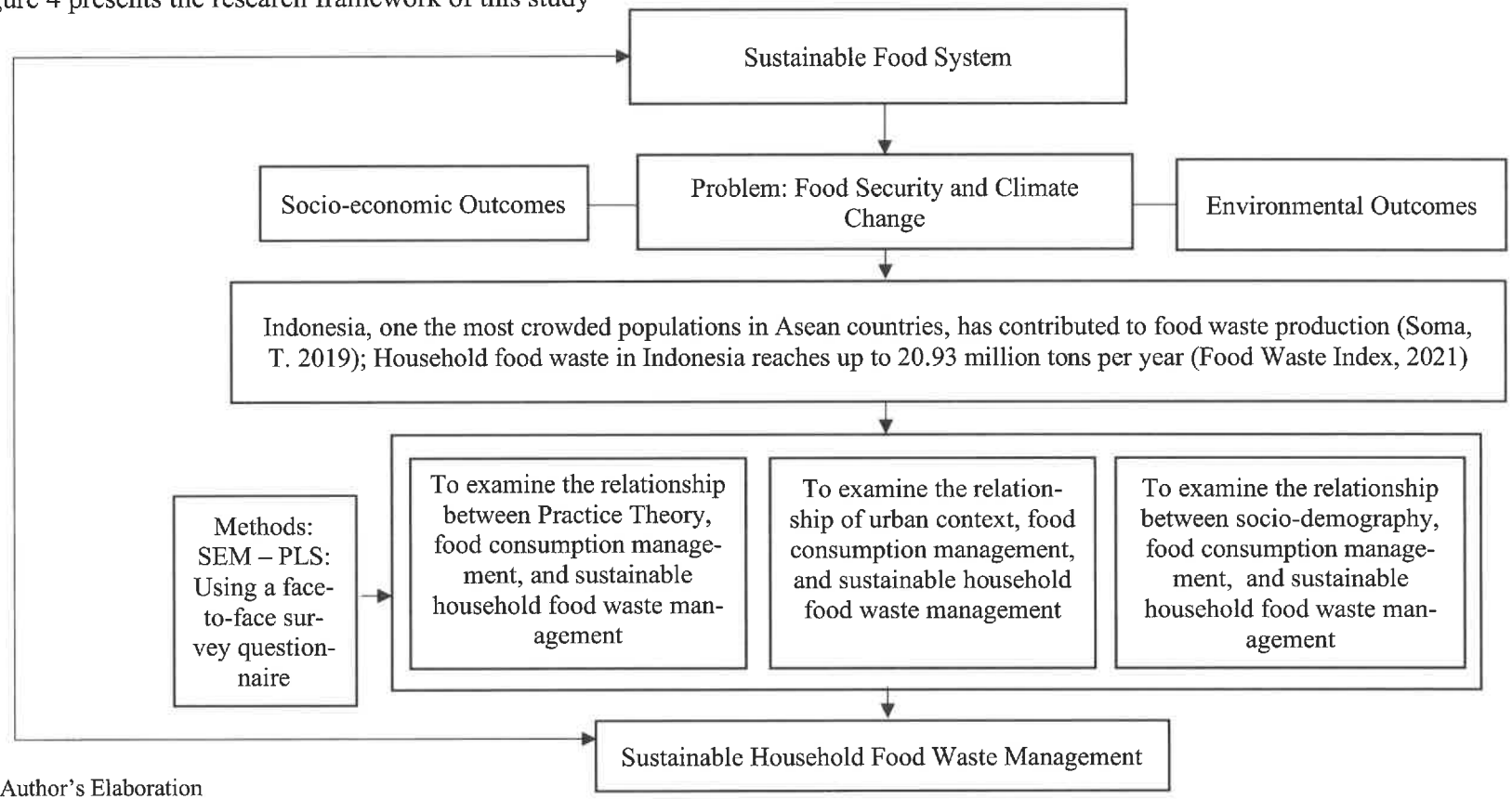
The main objective of the study will be achieved through the pursuit of the following **specific objectives:**

1. to define the amount of food waste and reasons for the waste of the main 15 categories of food,
2. to examine the relationship between the selected socio-demographic and economic characteristics (presence of child, age, household size, financial awareness), food consumption management, and sustainable household food waste management,
3. to examine the relationship between the 3 aspects of Practice Theory (competency and culinary skill, knowledge of food planning and composting, material and proper infrastructure), food consumption management, and sustainable household food waste management,
4. to examine the relationship between urban characteristics (healthy lifestyle, grocery shopping online, culture of food sharing, religion), food consumption management, and sustainable household food waste management.

The objectives of the study were achieved by answering the following research questions, based on the SEM-PLS results:

1. Haw much food of different categories do early stage families waste and what are the reasons for the waste?
2. What is the relationship between socio-demographic factors (presence of child, age, household size, financial awareness), food consumption management, and sustainable household food waste management in early-stage families in urban areas?
3. What is the relationship between Practice Theory (competency and culinary skill, knowledge of food planning and composting, material and proper infrastructure), food consumption management, and sustainable household food waste management in early-stage families?
4. What is the relationship between urban characteristics (healthy lifestyle, grocery shopping online, culture of food sharing, religion) and food consumption management in sustainable household food waste management in the early stages of a family?

The figure 4 presents the research framework of this study



Source: Author's Elaboration

Figure 4. Research Framework

To achieve a sustainable food system, it is important to consider the food processing through production, retailing, and the consumer. Along the process, there is some potential to generate waste. Waste is produced at the production level, known as food loss. The waste generated at the consumer level is called food waste. This study highlights food waste at the consumer level, specifically at the household level. One contributor to food security and climate change is food waste. This study focuses on food security and climate change.

The problem related to food security and climate change concerns socio-economic and environmental outcomes. Those factors interrelate with each other. This study was conducted in Indonesia, specifically in Bogor City. This location represents urban areas. In addition, Indonesia has a high population density and a significant volume of household food waste, estimated at 20.93 million tons per year according Food Waste Index 2021. The problem of household food waste is a crucial issue that requires empirical evidence-based solutions. Therefore, this research aims to examine the relationships between several variables. This study has three objectives: (1) To examine the relationship between socio-demography (presence of child, age, household size, financial awareness), food consumption management, and sustainable household food waste management, (2) To examine the relationship between Practice Theory (competency and culinary skill, knowledge of food planning and composting, material and proper infrastructure), food consumption management, and sustainable household food waste management (3) To examine the relationship between urban characteristics (healthy lifestyle, grocery shopping online, culture of food sharing, religion), food consumption management, and sustainable household food waste management

This study employed both quantitative and qualitative approaches. The quantitative approach, using a structured questionnaire, was administered to 350 respondents. A structured questionnaire contains several questions that represent those factors in a modelling form. This questionnaire uses a Likert scale from 1 to 5 for calculating the respondent's answer. This interview was conducted as a face-to-face survey. Then, there is a depth interview with respondents about the reasons for their attitude towards food waste in the household. The quantitative approach employed with Structural Equation Modeling–Partial Least Squares (SEM-PLS) as an analysis tool. Overall, this study aims to provide a more comprehensive understanding of the factors influencing sustainable household food waste management through a structured quantitative and qualitative approach, while considering empirical findings of socio-economic and environmental implications.

3.3 Research and Model Hypotheses

This study investigates the relationship among various variables in the context of sustainable household food waste management. The research develops twelve hypotheses, based on the rationale derived from the literature review and primary verification of the hypotheses described in the methodology chapter of this dissertation.

The hypotheses formulated in this study are considered research hypotheses, as they are systematically derived from established theoretical constructs and empirical evidence identified through a comprehensive literature review. These hypotheses focus on food consumption management, capturing critical household behaviors and strategies related to planning, purchasing, storing, and utilizing food efficiently. Specifically, they examine how variations in food consumption management influence sustainable household food waste management.

To enhance clarity, the relationships among the hypotheses, food consumption management, and sustainable household food waste management are visually summarized in Figure 5, which presents a graphical representation of the proposed model. Each hypothesis was carefully developed based on extensive literature evidence, ensuring that it is firmly grounded in prior research. The rationale for each hypothesis is detailed below, providing clear justification for their inclusion in the model.

Hypotheses 1-4 are based on the literature indicating that food waste production is influenced by socio-demographic factors. This study examines the influence of four socio-demographic characteristics of early-stage families on food waste production, i.e. presence of a child, age of spouses, size of the household and financial awareness.

Hypotheses 5-7 are designed to correspond to the three interrelated dimensions of Practice Theory: (1) material, (2) competence, and (3) meaning, by examining the relation of material and proper infrastructure, competency and culinary skills, knowledge of food planning and composting with food waste production. Hypotheses 8-12 refer to selected aspects of living in urban areas, proved to be significant to food waste production. These are: healthy lifestyle, grocery shopping online, culture of food sharing, religion and better food consumption management.

Hypothesis 1 (H1): The presence of a child has a direct negative influence on food consumption management.

The presence of children in households has been identified as a significant factor contributing to food waste. Research in China indicates that household composition, including the presence of children and elderly members, significantly explains the occurrence and proportion of food waste at the household level (Li et al., 2023). This phenomenon can be attributed to specific dynamics in households with children, such as altered consumption patterns, differing nutritional needs, and a tendency to purchase larger quantities of food to ensure availability.

Moreover, broader analyses highlight household size, including the presence of children, as a key driver of high food waste, due to more complex meal planning and stock management in larger households (Grainger et al., 2018). Households with children often struggle to synchronize food purchases with actual consumption, increasing the risk of food waste. Supporting this, a study in Germany found that perishable foods such as vegetables, fruits, and bread are the most commonly wasted items in households with children. The primary causes of this waste relate to quantity mismanagement, both at the point of purchase in smaller households and during storage in larger households with children (Herzberg et al., 2020). Parenting practices further influence children's eating behaviors and household food consumption. Authoritative parenting is associated with healthier eating habits and better physical and mental health outcomes, whereas less structured parenting is associated with poor dietary choices, including daily fast-food consumption (Zahra et al., 2013). These findings suggest that the presence of children, combined with caregiving and parenting practices, can complicate household food management by increasing the difficulty of enforcing food quality standards and coordinating intergenerational food choices.

Overall, recent studies indicate that children in households often pose challenges to optimal food consumption management. Their presence is associated not only with increased consumption of unhealthy foods among adults but also with impacts on children's dietary quality through feeding environments and parenting practices (Zahra et al., 2013). Thus, the direct negative influence of children on household food management can be understood through shifts in adult eating patterns and the complexities of child feeding, which may compromise the overall healthfulness of household food consumption and tend to generate food waste.

Hypothesis 2 (H2): Younger people have a direct negative influence on food consumption management.

Young people, particularly adolescents and young adults, have a significant influence on food consumption management, often negatively. This is reflected in unhealthy eating habits and increased food waste. Several studies have shown that young people, such as Generation Z students, have limited engagement in sustainable food consumption practices. For example, their efforts are typically limited to choosing seasonal and local foods, without a broader commitment to sustainability principles (Kamenidou et al., 2019).

Food waste is another important dimension where young people have demonstrated a negative impact on food consumption management. However, educational interventions emphasizing sustainable food systems have shown promising results, including reduced waste and increased healthier eating behaviors among adolescents. This suggests that well-targeted education can mitigate some of the negative effects, although regulatory support and facilities related to food waste reduction are also needed (Prescott et al., 2019). In general, young people's food consumption behaviors tend to negatively affect food management, reflected in lower diet quality, increased consumption of processed and ready-to-eat foods, increased food waste, and associated health risks. Interventions that integrate education about sustainable food systems and healthy eating patterns can help address this issue and encourage better consumption management among younger generations (Kamenidou et al., 2019; Prescott et al., 2019; Lee & Allen, 2020).

Interestingly, although younger generations recognize the importance of environmental stewardship, their behavior does not always reflect this awareness. Research shows that, for example, Gen Z has strong environmental knowledge and awareness of sustainable and ethical food consumption. However, their consumption practices are often hampered by time and budget constraints, especially when away from home. Their eating habits tend to be more sustainable at home than when traveling (Orea-Giner & Fusté-Forné, 2023). A survey in Poland found that many consumers still lack an adequate understanding of sustainability. Only a small proportion can link food consumption choices to environmental impacts. The main obstacles faced are price factors and limited knowledge, which cause eating behavior to not fully support the principles of sustainability, even though there is motivation to choose healthy or sustainable food (Rejman et al., 2019).

Hypothesis 3 (H3): A bigger household size has a direct negative influence on food consumption management.

A bigger household size is associated with significant impacts on food consumption management, generally indicating more complex, and often negative, effects on efficient food consumption. Evidence suggests that socioeconomic and demographic factors, including household size, significantly influence food consumption patterns such as food purchases and food management routines (Ananda et al., 2023). Larger households typically face challenges in food planning, storage, and waste prevention due to increased variability in food demand and the complexity of coordinating food-related activities. This can lead to inefficient food consumption management and higher levels of food waste unless strong drivers, such as food planning and storage practices, are in place, which can reduce household waste regardless of household size (Ananda et al., 2023). Furthermore, larger households, often with more members, tend to spend a greater proportion of income on staple foods such as cereals and starchy tubers, reflecting consumption patterns associated with meeting greater calorie needs (Chiaka et al., 2022). This increased demand can strain household food resources and complicate consumption management, especially under income and food security constraints. A bigger household size is also associated with greater biomass energy consumption for cooking, indirectly reflecting the demands of food preparation in larger households (Imran et al., 2022). Habit formation in food consumption is another factor relevant to household size, as family members' dietary habits can reinforce certain consumption patterns, potentially limiting adaptability and efficient food management in larger households (Wen et al., 2024). The presence of more people means more diverse food preferences and routines, adding to the complexity of managing consumption efficiently.

A bigger household size often has a direct negative impact on food consumption management due to increased food demand, complexity in routine planning and storage, higher likelihood of food waste, and economic constraints that affect dietary choices and food security. However, these effects can be mitigated by strong food management routines, motivation, and awareness of food planning and storage practices (Ananda et al., 2023; Chiaka et al., 2022; Imran et al., 2022).

Hypothesis 4 (H4): A household that has more financial awareness has a direct positive influence on food consumption management.

Households with higher economic capacity, greater financial awareness, and stronger food literacy tend to exhibit more positive attitudes toward healthy food consumption and are more willing to allocate greater resources to high-quality food products. This highlights the crucial role of financial awareness in shaping dietary choices and consumption decisions (Nam & Suk, 2024).

Moreover, financial literacy training, particularly when combined with empowerment programs, has been shown to improve household consumption patterns, including food-related expenditures, with positive effects on overall well-being and resource management capabilities (Koomson et al., 2021). In addition, women's empowerment in the context of household finance and agricultural activities is associated with enhanced food security, indicating that financial knowledge and capacity can contribute to more stable and sustainable household food consumption (Sharaunga et al., 2016).

Financial literacy also affects asset allocation strategies, which indirectly influence household consumption, including food management. Households with greater financial literacy are more likely to seek advice, remain informed about economic trends, and optimize their spending. This financial acumen translates into more efficient food budgeting, reduced food waste, and consistent food availability (Lu et al., 2021). Beyond financial factors, household food consumption and waste behaviors are shaped by planning and purchasing decisions. Households that carefully plan their food purchases and avoid impulsive buying tend to generate less food waste, reflecting more effective consumption management (Janssens et al., 2019; Chen, 2019). Accordingly, financial literacy that supports such planning can facilitate more sustainable management of household food resources.

Enhanced financial awareness equips households with the knowledge and skills necessary to optimize food consumption management through informed purchasing decisions, strategic budget allocation, and efficient spending. This relationship is further reinforced by targeted literacy and empowerment programs, ultimately promoting food security and reducing food waste (Nam & Suk, 2024; Koomson et al., 2021; Sharaunga et al., 2016; Lu et al., 2021).

Hypothesis 5 (H5): Competency and culinary skills have a direct positive influence on food consumption management.

Competency and culinary skills positively influence food consumption management, as supported by numerous studies across diverse populations and intervention

contexts. Culinary skills refer to the practical ability to prepare and cook food, while competencies encompass the knowledge, confidence, and planning skills necessary to make nutritious food choices and engage in healthy eating behaviors. Intervention studies have shown that improving cooking skills and culinary competencies not only increases participants' self-confidence but also the frequency of cooking at home and the consumption of healthy foods, such as fruits and vegetables.

Improving culinary skills contributes to an individual's ability to manage food more effectively, plan menus more effectively, foster creativity, and enhance the enjoyment of cooking. These aspects play a crucial role in promoting sustainable home cooking practices and reducing reliance on processed foods, thereby reflecting more effective food consumption management (Finkelstein et al., 2025). In addition, a study shows that adolescents with higher self-perceptions of their culinary skills tend to produce better food quality, especially when selecting and preparing ingredients (Rosa et al., 2022).

Community-based cooking skills programs consistently report increased cooking confidence among adults of various ages and socioeconomic backgrounds, which correlates with small but significant increases in fruit and vegetable intake (Garcia et al., 2016).

Improving culinary skills directly increases individuals' self-efficacy in the kitchen, a key factor in managing food consumption. Research in both clinical and community settings has shown increased self-efficacy related to meal planning, cooking from scratch, and healthy food preparation following culinary training or education (Polak et al., 2017; Sharma et al., 2021).

Hypothesis 6 (H6): Knowledge of food planning and composting has a direct positive influence on food consumption management.

Knowledge of meal planning and composting practices is crucial for improving food consumption management. This relationship can be understood by integrating studies on dietary behavior, nutrition knowledge, environmental cues, and habit formation.

First, nutrition knowledge and education are fundamental to developing healthier eating habits and improving food management. Increased nutrition knowledge has been shown to enable individuals, including adults with obesity, to make dietary changes that positively impact health, such as reducing consumption of sugar, processed meat, and fat, and increasing lean protein intake. These changes ultimately contribute to weight loss and a reduced risk of cardiovascular disease (López-Hernández et al., 2020). This

confirms that knowledge directly influences food choices, thereby promoting more balanced and healthier consumption patterns.

Second, food planning, which includes intentional food preparation and selection, can address common barriers to healthy eating, such as time constraints, easy access to high-calorie foods, and the availability of fast food. For example, university students identified meal planning and involvement in meal preparation as important factors in supporting healthy eating behaviors, emphasizing the importance of planning knowledge for effective food intake management (Sogari et al., 2018).

Furthermore, habit formation significantly influences long-term food consumption patterns. Studies in rural China have shown that consumption habits influence diet structure, nutrient intake, and responses to changes in income. Repeated consumption of certain food categories influences the elasticity of food choices and long-term nutritional outcomes, suggesting that early meal planning knowledge can help establish beneficial dietary habits and positively influence consumption management over time (Wen et al., 2024).

Composting practices also contribute to sustainable food consumption management. Composting converts food waste into nutrient-rich organic fertilizer, which helps restore soil fertility by recycling essential nutrients such as nitrogen, phosphorus, and potassium. This reduces reliance on chemical fertilizers, lowers farming costs, and supports sustainable agricultural practices. By closing the nutrient cycle, composting enables a food production system better aligned with consumer needs, while reducing overproduction that can lead to food waste (Mngadi et al., 2025; Dey et al., 2024). Composting is part of a sustainable food waste management practice integrated with education and policy reforms that emphasize consumer behavior change. These efforts aim to reduce overconsumption and food waste by raising awareness of environmental impacts and encouraging diets aligned with sustainability goals. Additional strategies, such as agile food service management, media literacy for sustainable consumption awareness, and the implementation of a policy-supported waste hierarchy, further strengthen composting's role in promoting responsible consumption management (Deksne et al., 2025; Mehrotra et al., 2024; Chamcham et al., 2024).

Hypothesis 7 (H7): Material and proper infrastructure have a direct positive influence on food consumption management.

Material and proper infrastructure play a crucial role in ensuring a smooth supply chain connecting producers, distributors, retailers, and consumers. This infrastructure

contributes to preventing supply shortages and the risk of food contamination, making it crucial to maintaining consistent and safe food availability. For example, transportation infrastructure and refrigeration systems play a crucial role in maintaining food quality and extending the shelf life of products from farm to consumer, which in turn directly impacts the management and sustainability of food consumption (Pilcher, 2016).

Hypothesis 8 (H8): Healthy lifestyle has a direct positive influence on better food consumption management.

Healthy lifestyle habits, which encompass balanced nutrition, regular physical activity, and psychological well-being, play a crucial role in promoting positive dietary behaviors. For example, mindfulness-based interventions have been shown to effectively improve healthy eating behaviors among university students by encouraging balanced diets, regulating intake, and reducing maladaptive eating patterns such as emotionally driven snacking (Soriano-Ayala et al., 2020). These findings indicate that fostering the psychological components of a healthy lifestyle can directly enhance food consumption management by improving self-regulation, increasing awareness of eating behaviors, and supporting more deliberate and sustainable food choices.

Those hypotheses cover the lifestyle indicators that are relevant to the urban factors. Reducing food waste is facilitated by adopting a balanced diet and making dining at home a habit (Savelli et al., 2019). Recent studies explain that lifestyle is divided into two characteristics in terms of food research: (a) preference for online shopping and (b) food preparation.

Hypothesis 9 (H9): Grocery shopping online has a direct positive influence on better food consumption management.

Consumers who shop for groceries online tend to exhibit higher planning and lower impulsivity. This effect arises because the online grocery environment typically requires shoppers to select items from categorized menus or pre-defined lists, which inherently encourages adherence to a planned shopping strategy rather than spontaneous purchases. Research has shown that barriers to impulsive buying are more pronounced in online settings due to their task-oriented design and the deliberate process of adding items to a digital shopping cart. This contrasts with physical stores, where hedonic cues and visual merchandising can trigger unplanned purchases (Chih et al., 2012; Nyrhinen et al., 2023). In addition, younger consumers tend to shop for groceries online (Zhang et

al., 2020). Online grocery shopping has a positive influence on sustainable food consumption (Bryla, 2018; Yang, Li, and Zhang, 2018). Technological advance also has role in the urban context. For example, there are several online application that provide ready-meal food so that consumers are able to purchase through online.

Hypothesis 10 (H10): Culture of food sharing has a direct positive influence on food consumption management.

A food-sharing culture can positively influence food consumption management and help reduce food waste. This is reflected in several studies that emphasize the roles of social norms, collective awareness, and shared behavior in food consumption practices. Social norms and anticipated positive emotions have been shown to influence consumer intentions and behaviors aimed at minimizing food waste. A sense of community and social responsibility, for example, can encourage individuals to adopt food management practices such as consumption planning and efficient storage, ultimately reducing household food waste (Mumtaz et al., 2022; Ananda et al., 2023). These management routines then develop into habits reinforced by social expectations regarding sustainability and sharing practices, thereby increasing the overall effectiveness of food consumption management.

Hypothesis 11 (H11): Religion has a direct positive influence on food consumption management.

Religion and cultural dimensions are integral components of urban context. Religious and cultural practices have been shown to positively influence environmental awareness by shaping values, norms, and everyday behaviors (Aschemann-Witze, 2015; Abelradi, 2017). In Indonesia, where Islam is the dominant religion, teachings that emphasize moderation in eating and drinking provide a normative framework that can support responsible food consumption.

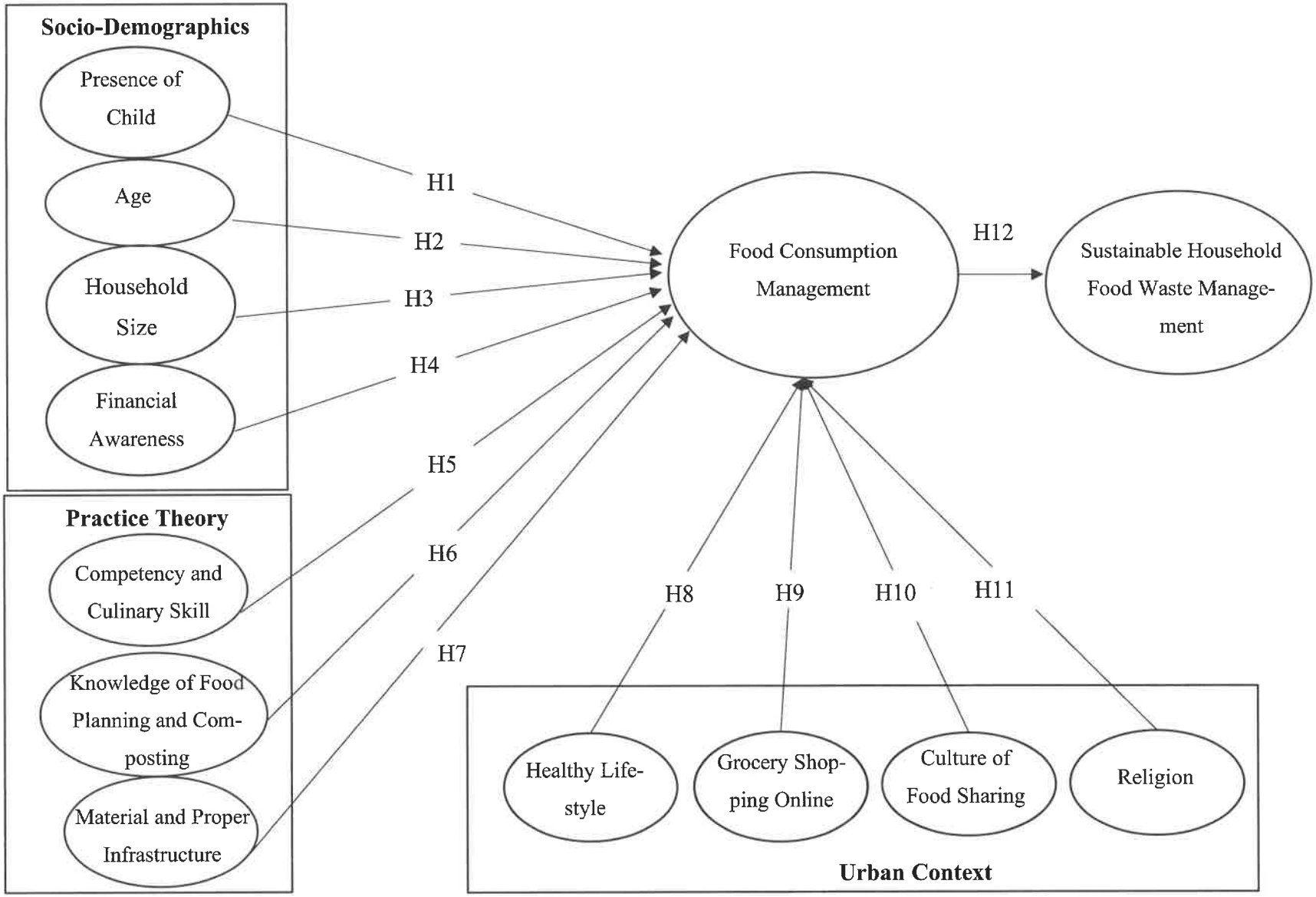
However, cultural and religious celebrations, particularly large festive events, often involve the preparation and distribution of excessive amounts of food, which can inadvertently contribute to increased food waste. Such practices are observed across many countries and highlight a tension between cultural traditions and sustainable consumption goals. Nevertheless, communities rich in cultural capital, including strong religious and cultural traditions, can serve as catalysts for enhanced environmental

awareness and the promotion of green economic growth in urban contexts when sustainability principles are integrated into these practices (Wan, 2024).

Hypothesis 12 (H12): Food consumption management has a direct positive influence on sustainable household food waste management.

Food consumption management encompasses a range of proactive behaviors, such as meal planning, avoiding impulse purchases, utilizing leftovers, and carefully monitoring expiration dates to minimize waste. Several studies have shown that households that implement these management strategies tend to produce less food waste. For example, analysis during the COVID-19 pandemic revealed that improved work-life balance and improved time management contributed to more planned food consumption patterns, thereby helping to reduce household food waste (Amicarelli & Bux, 2020). These findings confirm that households that actively manage their food consumption are more likely to adopt sustainable waste management practices.

Similarly, consumer behavior research shows that households with clear waste reduction goals significantly reduce food waste. This indicates that a household's intention and commitment to minimizing waste significantly influence purchasing and consumption habits, which ultimately determine the amount of food wasted (Ntai et al., 2025). Therefore, effective food consumption management not only prevents excessive waste but also fosters stronger engagement with sustainability issues related to food waste.



Source: Author's Elaboration

Figure 5. Initial Model (SEM-PLS)

4. Research Methodology

4.1 Research Design

This study used quantitative and qualitative methods (QDA). Quantitative methods included face-to-face surveys. The survey used a Likert-scale questionnaire (1–5). The qualitative method involved in-depth interviews with the respondents. The in-depth interviews were conducted to explore more detailed information about food waste production at an early stage of the family.

This study consisted of three stages in collecting data: (1) a literature review to obtain the structured questionnaire; (2) a face-to-face survey using the questionnaire; and (3) in-depth interviews were carried out with selected respondents to gain a deeper understanding of their responses to the questionnaire.

The first step involved developing a questionnaire based on insights from the literature review and constructing the theoretical model for the research, which included 12 hypotheses to be tested.

The second stage focused on collecting primary data by distributing the questionnaire. This process began with the use of secondary data obtained from sub-district offices in Bogor City and Bogor Regency, which served as a basis for identifying and selecting suitable respondents for the study. The initial information obtained from secondary data included the respondent's name, address, age, and marital status. In the next stage of data collection, enumerators approached potential respondents to confirm their willingness to participate in this study. Before proceeding with the full questionnaire, enumerators first verified several preliminary criteria to ensure the respondent fitted the study requirements. If the respondent meet these criteria, the interview continued. However, if the respondent did not qualify, the interview was discontinued. In addition, the enumerator provided respondents with a consent form (Appendix 1). Before asking for their signature, the enumerator explained key details about the research, including its purpose, scope, and objectives. Respondents were also informed about the procedures they will undergo, any potential risks, the expected benefits, their right to refuse or withdraw at any time, the confidentiality of their data, and any incentives offered for participation after the interview is finished.

The third stage involved conducting in-depth interviews to gain a deeper understanding and further clarify respondents' answers. A selected number of participants from the second stage were interviewed again to explore their responses in greater detail.

4.2 Methods of Data Analysis - Structural Equation Modelling–Partial Least Squares

The data were processed and analysed using descriptive statistics and Structural Equation Modelling–Partial Least Squares (SEM-PLS).

Descriptive analysis was used to assess respondents' socio-demographic characteristics and estimate household food waste. It involved examining past data to uncover trends and patterns. It used statistical methods and visual tools to derive insights that support decision-making across fields, such as analysing population demographics (Geetha & Sujatha, 2024). This approach makes information easier to understand.

To analyse respondents' demographic characteristics and estimate household food waste, the following key indicators were applied:

(1) age,

(2) duration of marriage,

(3) number of children,

(4) responsibility in managing food consumption,

(5) household size,

(6) monthly food expenses, and

(7) monthly income.

Their operational definitions are explained in Table 1

To estimate household food waste, food items were categorized into 15 product groups. These categories include both edible and non-edible food waste, allowing for a more detailed and accurate understanding of waste patterns within households. These are (1) fresh vegetables (2) non-fresh vegetables (jar /food canned/frozen) (3) fresh fruit (4) rice (5) beans, lentils, chickpeas, et cetera (6) meat, beef (7) fish (8) bread (9) egg (10) soup/curry (11) sauce (ketchup, mayonnaise, cocktail sauce, et cetera) (12) candy/cookies/granola bars/chocolate bars/ crisps/ nuts/ chocolate (13) beverages (milk, juice, soda. excluded: water, tea, coffee, diluted syrup) (14) seasoning (15) cereals, tubers and their derivative. Measure the amount of food waste using the illustration tablespoon, bowl, slice/pieces (Appendix 2).

This study assesses the household food waste model using **Structural Equation Modelling (SEM)**. While theoretical models establish causal relationships, these will be tested. SEM is an analysis technique developed to address limitations of the classic technique, namely Ordinary Least Squares (OLS), especially in analysing latent and complex models (Adedeji et al., 2016). In contrast to statistical methods such as parametric, non-parametric, or multivariate, SEM involves many very complex mathematical calculations. SEM is a multivariate analysis technique that combines factor analysis and path analysis. Factor analysis tests the validity and reliability of an instrument (measurement scale), while path analysis examines the relationship between variables.

The Partial Least Square (PLS) path modelling technique, originally proposed by Wold (1982), functions through a structured algorithm. It was further refined by Henseler et al. (2009), who designed it to perform iterative regressions using weight vectors. Once these weight vectors stabilize, they satisfy specific fixed-point equations, a concept further clarified by Dijkstra (2010).

This study employed Partial Least Squares Structural Equation Modelling (PLS-SEM) rather than Covariance-Based Structural Equation Modelling (CB-SEM) for methodological reasons. PLS-SEM offers significant benefits for predictive modelling and explaining variance, particularly when dealing with small sample sizes or complex model structures. In contrast to CB-SEM, which relies heavily on model fit indices and often requires larger samples for reliable results, PLS-SEM focuses on maximizing explained variance and evaluating measurement models using reliability and validity measures such as Cronbach's alpha, Composite Reliability (CR), and Average Variance Extracted (AVE). This study did not conduct Confirmatory Factor Analysis (CFA), a key component of CB-SEM, since CFA is not a necessary procedure within the PLS-SEM framework.

4.3 Sampling Method

To meet the requirements of the SEM model, the sample size should be substantial, with at least 200 participants (Kline, 2011). According to Hair et al. (2011), the minimum sample size for SEM-PLS analysis should be ten times the highest number of structural (inner) or measurement (outer) model paths directed at any latent variable. In this study, the maximum number of such paths is 12, indicating a minimum required sample size of 120 respondents. Moreover, since no exact population data are available for early-stage families living in the urban areas of Bogor City and Bogor Regency, this study uses the

guidelines proposed by Kline (2011) and Hair et al. (2011) to determine an appropriate minimum sample size. Consequently, the total sample of the survey carried out for this dissertation is 350 respondents.

This study used a non-probability sampling technique, specifically purposive sampling, to collect data. Purposive sampling was chosen because it would best represent early-stage families living in urban areas. The criteria for selecting respondents in this research were as follows:

(1) One or both spouses were aged between 18 and 40 years old in 2024; this study used a broader age range for early-stage families to match current cultural changes in Indonesia, where fewer young people are getting married.
(2) They lived in Bogor City or Bogor Regency.
(3) They lived together as a nuclear family (father, mother, and children).
(4) They had children, with the eldest no older than 12 years (aligning with Duval's family life cycle stage: families with school-age children).
(5) They were financially independent and not reliant on extended family members who may live in the same house.

This research focuses only on intact nuclear families to avoid financial bias. Single-parent families or divorced families were excluded, as in Muslim majority contexts, divorced fathers are still legally required to support their children, which can affect household financial dynamics.

Table 1. Operational Definitions and Indicators of Latent Variables

No	Variables	Definition	Indicators
1	Presence of a Child	Refers to whether children live in the household and how their presence affects family routines and food management.	1. Challenges in managing food consumption since having children 2. Difficulty in handling leftovers 3. Changes in food management routines 4. No change in food management
2	Age	Refers to the chronological age of the primary person responsible for food management in the household.	1. Self-reported inability to manage food consumption effectively 2. Less concern about food quantity and quality 3. Self-reported tendency to generate food waste
3	Household Size	Refers to the number of people living together and how it influences food	1. Irregular or no meal planning 2. Purchasing incorrect food quantities 3. Improper storage practices 4. Frequency of food spoilage or expired products

No	Variables	Definition	Indicators
		consumption and waste generation.	5. Irregular meal times and skipped meals
4	Financial Awareness	Refers to the awareness and management of household food expenditure and budgeting to minimize waste	1. Avoiding unnecessary food expenses 2. Buying based on desire rather than need 3. Impulse buying 4. Planning purchases to reduce waste
5	Competency and Culinary Skill	Refers to the knowledge, skills, and ability to prepare and manage food efficiently in the household	1.Managing household food consumption effectively 2.Reducing household food waste 3.Serving meals according to family needs
6	Knowledge of Food Planning and Composting	Refers to the understanding and application of meal planning, portion control, and composting practices.	1.Reducing food waste through meal planning 2.Cooking and serving food according to family needs 3.Using planning knowledge to reduce environmental impact 4. Practicing composting
7	Material and Proper Infrastructure	Refers to the availability of tools and infrastructure for food management	1. Availability of refrigerator for food storage 2. Proper food storage facilities 3. Kitchen equipment that supports food management and waste reduction.
8	Healthy Lifestyle	Refers to the adoption of health-oriented behaviors, including dietary choices and routines that affect food consumption.	1. Focus on family food consumption patterns 2. Attention to quality and quantity of food 3. Efficient food planning, processing, and serving
9	Grocery Shopping Online	Refers to the practice of purchasing groceries via online platforms and its effect on food management.	1.Shopping according to planned list 2.Frequency of impulse buying online 3.Online shopping reduces overbuying 4.Frequency of online grocery shopping (per week) 5.Reasons for preferring online shopping
10	Culture of Food Sharing	Refers to social and cultural practices of sharing food to reduce waste and promote sustainability.	1. Sharing food reduces household food waste 2. Sharing food avoids unnecessary waste and promotes sustainability
11	Religion	Refers to the influence of religions and teachings on food consumption and waste behavior.	1. Religious teachings guide food planning 2. Religious teachings discourage food waste 3. Religious practices influence serving according to family needs
12	Food Consumption Management	Refers to household practices in planning, processing, serving, and minimizing food waste.	1. Making a shopping list to reduce waste 2. Efficient food processing 3. Serving food according to family needs

No	Variables	Definition	Indicators
13	Sustainable Household Food Waste Management	Refers to practices aimed at reducing household food waste while considering environmental, economic, and social sustainability.	1. Reducing waste by learning about environmental, economic, social impacts 2. Reduce household food waste by being willing to use the leftover 3. Separating food and non-food waste

Source: Author's elaboration based on literature review

4.4 Evaluation of the Research Feasibility

Research Design: This study was conducted in Bogor, part of Indonesia. Bogor is one of the metropolitan cities that represent an urban area in Indonesia. Bogor has a diverse population and provides an appropriate context for studying food waste at the early stage of family formation. Additionally, the availability of data from the Central Bureau of Statistics Indonesia (BPS) and the Ministry of Development Planning (Bappenas) contributed to the existing knowledge base and provides a foundation for the research project. This study consisted of three stages in collecting data and covered qualitative and quantitative methods:

(1) a literature review to obtain the structured questionnaire;

(2) a face-to-face survey; and

(3) an in-depth interview.

All of these stages provide more detailed information.

Resource Availability: This study was conducted through face-to-face interviews and focus group discussions. The total sample was 350 respondents. It is aligned with the representative population of urban areas in Indonesia in terms of the early stages of the family.

Timeframe: The total duration of this study was around 4 years (based on the duration of the doctoral degree timeframe). It began with the review of previous studies, elaborating the initial concept of the research, the development of the questionnaire to collect data, the pre-survey, the survey, the analysis of the data, and the report writing.

Research Team: All stages of the research were developed by the author. However, to collect data, the author hired enumerators (persons who collect the data), who were trained by the author to conduct interviews using the questionnaire. This study needed enumerators to collect data due to the large number of respondents.

Ethical Consideration: To protect respondents' rights and privacy, this study required consent from all respondents, who were provided with the explanation of the purpose of the survey and procedures applied. Participation in the survey was voluntary, without coercion, and respondents had a clear understanding of how their data would be collected, used, and stored.

5. Results

5.1 Socio-demographic and Economic Characteristics of Respondents

Descriptive analysis of the demographic and economic characteristics of 350 married couples participating in this study is presented in table and table.

Table 2. Socio-demographic Characteristics of the Surveyed Households

Characteristics	Category		n	%
Age	Husband	18-25 years old	11	3
		26-32 years old	119	34
		33-40 years old	**220**	**63**
	Total		**350**	**100**
	Wife	18-25 years old	63	18
		26-32 years old	**178**	**51**
		33-40 years old	109	31
	Total		**350**	**100**
Period of Marriage	< 5 years		75	21
	5 – 10 years		**211**	**60**
	11- 15 years		59	17
	>15 years		5	2
	Total		**350**	**100**
Number of Children	1 child		143	41
	2 children		**166**	**47**
	3 children		34	10
	4 children		7	2
	Total		**350**	**100**
Responsible in Food Consumption Management	Husband		60	17
	Wife		**290**	**83**
	Total		**350**	**100**
Household Size	3 persons		145	41
	4 persons		**164**	**47**
	5 persons		34	10
	6 persons		7	2
		Total	350	100

Source: author's elaboration based on the survey.

According to Table 2, In terms of age, most husbands were in the 33-40 age range (63%), while most wives were in the 26-32 age range (51%). The length of marriage varies, but most were in the 5-10 year range (60%), while only 2% of couples were married for more than 15 years. In terms of family size, the majority of households had 1–2 children (88%), whereas only 12% had 3–4 children. In the Indonesian context, the government strongly promotes family planning programs, encouraging couples to limit their family to a maximum of 2 children. These programs reflect Indonesia's national policies aimed at population control and improving family welfare.

In managing household food consumption, wives play a dominant role, accounting for 83%, while husbands account for 17%. Wives' dominance in managing household food consumption is influenced by factors at the individual, relational, and sociocultural levels. Sociocultural, social and cultural norms traditionally place women as primarily responsible for domestic work, including planning, purchasing, and preparing food. This role assignment reinforces the construction of women as the primary caregivers and household managers. Several studies show that women tend to be more involved in household work and caregiving than men, thereby establishing their dominant position in household food management (Lake et al., 2006; Knudsen & Waerness, 2007; Renzella et al., 2020). At the relational level, wives often internalize a stronger sense of obligation to caregiving and household management, including food consumption. This sense of responsibility is closely related to the emotional and social expectations placed on women within the family context, ultimately reinforcing their dominance in food-related tasks (Collins & Jones, 1997). Furthermore, gender-based norms within the family often place women in a self-sacrificial role, further solidifying their position as the primary actors in household food management (Loban et al., 2024).

From a functional perspective, household food management involves a series of routine behaviors, such as menu planning, purchasing food ingredients, storing, and processing food. These activities tend to become habits, formed and maintained over the long term. These routines align with women's role in organizing and maintaining household order and are supported by social norms and motivations that emphasize the importance of efficient food management to minimize waste and ensure food availability (Ananda et al., 2023). Wives' dominance in household food management is a result of sociocultural gender role constructions that assign women primary responsibility for domestic work, the internalization of relational obligations and expectations within the

family, and the establishment of habitual routines related to food management that are traditionally maintained by women (Loban et al., 2024; Ananda et al., 2023).

In the household size category, households generally consist of 3-4 members (88%), while households with more than 5 members are only 12%. Mulyo et al. (2025) state that the number of families in Indonesia was a significant factor influencing food consumption management, beginning from provisioning, storage, and disposal. In addition, a large amount of food waste occurred in one, three, and four-person households compared to households with two persons. This is due to the differences in preferences and consumption needs among people (Yu & Jaenicke, 2020; Heng & House, 2021).

Table 3. Economic Characteristics of the Surveyed Household

Characteristics	Category			n	%
Food Expenses/Month	< IDR 1 000 000	< €57	< $61.54	22	6
	IDR 1 000 000 – 2 000 000	€57 – €114	$61.54 – $123.08	**145**	**41**
	IDR 2 100 000 – 3 000 000	€119,7 – €171	$129.23 – $184.62	60	17
	IDR 3 100 000 – 4 000 000	€176,7 – €228	$190.77 – $246.15	58	16
	IDR 4 100 000 – 5 000 000	€233,7 – €285	$252.31 – $307.69	49	15
	>IDR 5 000 000	> €285	>$307.69	16	5
	Total			**350**	**100**
Income/Month	< IDR 2 000 000		< $123.08	10	3
	IDR 2 100 000 –5 000 000		$129.23 – $307.69	**177**	**51**
	IDR 5 100 000 –7 500 000		$313.85 – $461.54	66	19
	IDR 7 600 000 –10 000 000		$467.69 – $615.38	66	19
	>IDR 10 000 000		> $615.38	31	9
	Total			**350**	**100**

Note: Exchange Rates (July 2024):

1 IDR ≈ €0.000057

1 IDR ≈ $0.000062

Source: author's elaboration based on the survey.

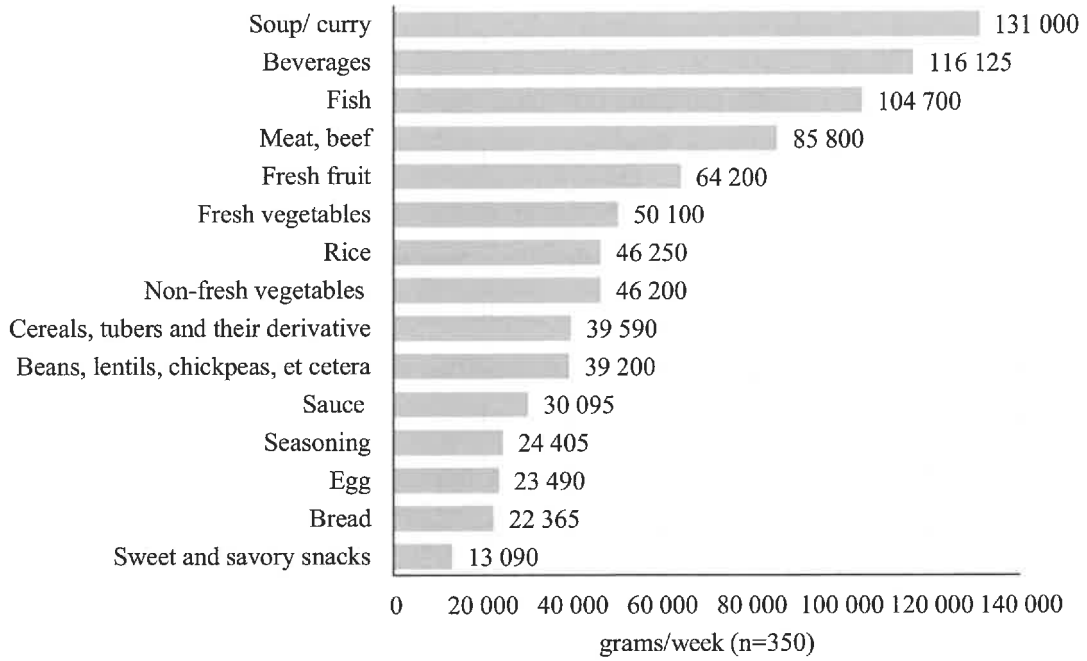
Based on Table 3, monthly food expenditure varies, but most families allocate funds between IDR 1 000 000 and IDR 2 000 000 (41%), while only 5% spend more than IDR 5 000 000 per month. In terms of income, most families have a monthly income between IDR 2 100 000 – IDR 5 000 000 (51%), while only 9% have an income of more than IDR 10 000 000.

Household income is significantly related to household expenditures, both on food and non-food items. Studies show that higher income is usually accompanied by higher expenditures on both food and non-food items. Research conducted in Tanzania indicates that household food expenditures average around 65–70% of total expenditures, and this expenditure increases with increasing household income (Rashid et al., 2024). Meanwhile, research in Canada shows that low-income households tend to have lower total food expenditures than higher-income households and have less access to nutritious foods such as milk, fruits, and vegetables (Kirkpatrick and Tarasuk, 2003). This suggests that access to quality food is influenced by both income and food prices. Furthermore, there is a correlation between the proportion of food and non-food expenditures as income increases. The proportion of food in household expenditures decreases with increasing income. Similarly, the proportion of the budget allocated to food items shifts to other non-food items as income increases. According to the findings, low-income households have a higher elasticity of food expenditure than high-income households, in accordance with Engel's law (Aryal & Aryal, 2023)

Overall, these data provide an overview of the age structure of couples, the length of marriage, the number of family members, household spending patterns, and the roles in managing food consumption. This shows that most families in this study are in the productive age stage, with relatively few family members and spending patterns structured by income level. As representatives of the target respondents in this research, families in the early stages of life or young families with children are included.

5.2 The Amount of Food Waste Based on the Product Category

This study also calculated the amount of food waste per household per week across 15 product categories shown in figure6, where the food loss is expressed in grams per week.



Sources: author's own elaboration based on survey.

Figure 6. Amount of Food Waste by Category Based on the Survey

According to the Figure 6, several food categories generate high levels of waste, with soup and curry being the most wasted, totalling 131 000 grams total discarded by the surveyed households per week. This is followed by fish at 104 700 grams per week, meat at 85 800 grams, and fresh fruit at 64 200 grams. Fresh vegetables, rice, and processed products like nuts and spices also contribute significantly to food waste. Fish, meat, and fresh fruit are among the top categories contributing to waste. The main cause of this waste is due to portion sizes that are too large, leading to food being left on plates, pots, or pans after eating. This occurs with various foods, including fresh vegetables, rice, meat, fish, and nuts. Additionally, foods that spoil quickly or change in texture and taste are often wasted. Perishable items, such as fresh fruit, are often discarded because they become soft or sticky during storage. For example, fresh fruit is often thrown away after storage because it becomes soft or sticky, and bread is wasted because it is bought in excess and not eaten before it expires. Other reasons for food waste include improper food storage, which causes spices, sauces, and packaged foods to spoil quickly. Foods like eggs and meat are sometimes thrown out because they develop an unpleasant smell, while snacks like biscuits, chocolates, and chips are discarded because people are not accustomed to eating leftovers from the previous day. Additionally, drinks such as milk

and juice are often thrown away because they change color or texture over time. Overall, the main factors behind food waste are large portion sizes, the habit of purchasing excessive amounts of food, and a lack of awareness about proper storage and consumption practices. This highlights the need to change food habits and storage methods to significantly reduce food waste.

The results indicate that the majority of household food waste is disposed of directly into the trash, without any processing or utilization. This behavior reflects limited engagement in food waste management practices, such as recycling, composting, and repurposing leftovers.

Table 4. The Amount of Food Waste in each Food Category, Expressed in Grams per Week

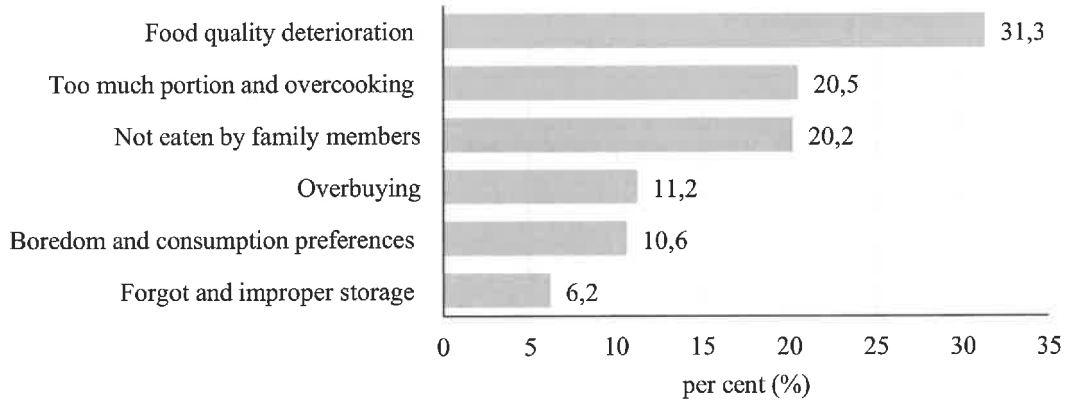
No	Product Category	Gram/week (n=1)	Gram/day (n=1)
1	Soup / curry	391	56
2	Beverages (milk, juice, soda. Excluded: water, tea, coffee, diluted syrup)	332	47
3	Fish	299	43
4	Meat, Beef	245	35
5	Fresh fruit	183	26
6	Fresh Vegetables	143	20
7	Rice	136	19
8	Non-fresh vegetables (jar /food canned / frozen)	132	19
9	Cereals, tubers and their derivative	113	16
10	Beans, lentils, chickpeas, et cetera	112	16
11	Sauce (ketchup, mayonnaise, cocktail sauce, et cetera)	93	13
12	Seasoning	70	10
13	Egg	67	10
14	Bread	64	9
15	Sweet and savory snacks (candy / cookies / granola bars / chocolate bars/ crisps/ nuts/ chocolate)	37	5

Sources: author's own elaboration based on the survey.

According to Table 4, soup or curry produces the largest amount of household waste, expressed in grams per day and per week. The amount of daily household waste is 56 grams. The data indicate that the largest portion of this waste consists of food leftovers from plates, pots, or pans. This suggests that most waste in this category originates from

cooked food that is not fully consumed, offering valuable insights into household food waste patterns.

Figure 7 presents the percentage distribution of reasons for food waste in the soup/curry category. The most frequent reason for curry waste is deterioration in food quality, including spoiled, expired, bad smell, texture changes (lumpy/sticky), colour changes, and past 'best before' date (31.3% of responses), while the least frequent reason is forget and improper storage (6.2% of responses). The second and third reasons are too much portion and overcooking (20.5% of responses), and some family members are unable to finish (20.2% of responses). Additionally, most respondents refrain from consuming the soup the following day due to anticipated changes in texture and a perceived lack of freshness.



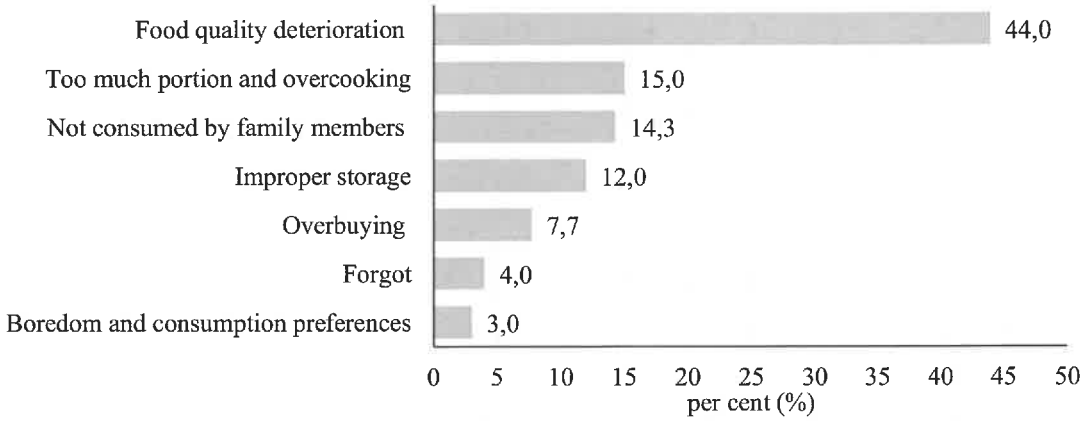
Sources: author's own elaboration based on the survey.

Figure 7. Reasons for Household Waste from Soup/curry as a Percentage of All Responses (n=350)

According to Table 4, beverages, including milk, juice, soda, and excluding water, tea, coffee, and diluted syrup, produce the second-largest amount of household waste, expressed in grams per day and per week. The amount of daily household waste is 47 grams. The data indicate that this waste primarily consists of leftover drinks that are not consumed and subsequently discarded, highlighting that unconsumed beverages represent a significant portion of household food and drink waste.

Figure 8 presents the percentage distribution of reasons for food waste in the beverages category. The most frequent reason for beverage waste is deterioration in food quality, including spoiled, moldy, bad smell, texture/color changes, and expired (44% of responses), while the least frequent reason is boredom and consumption preferences, such as children get bored quickly or a preference for fresh food (3% of responses). The

second and third reasons are too much portion and overcooking (14% of responses), and not consumed by a family member, including leftovers by children (13.33% of responses). Beverages such as milk, juice, and soda have greater economic and environmental value than water.

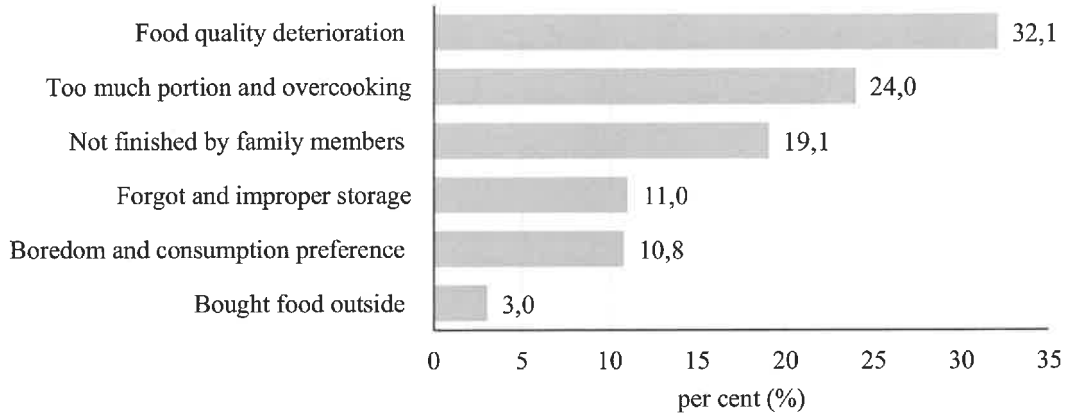


Sources: author's own elaboration based on the survey.

Figure 8. Reasons for Household Waste from Beverages as a Percentage of All Responses (n=350)

According to Table 4, fish are the third-largest amount of household waste, expressed in grams per day and per week. The amount of daily household waste is 43 grams. The data indicate that the largest portion of this waste consists of leftovers from plates, pots, or pans, suggesting that most of this waste originates from cooked fish that is not fully consumed. Fish is widely consumed in Indonesia, deeply embedded in dietary habits due to the country's island geography and cultural heritage that emphasizes marine foods. This consumption pattern is also supported by historical sea-based migrations and the reliance on fish as a primary source of animal protein, although intake adequacy may vary among specific subpopulations, such as adolescents (Tumonggor et al., 2013; Rachmi et al., 2020; Kusuma et al., 2015). Consequently, the relatively high amount of fish waste reflects both its frequent consumption and the common occurrence of plate leftovers. The products in this research are salted fish, Gourami, and Mackerel tuna.

Figure 9 presents the percentage distribution of reasons for food waste in the fish category. The most frequent reason for fish waste is deterioration in food quality, including spoiled, moldy, bad smell, texture/colour changes, and expired (32.1% of responses), while the least frequent reason is buying food from outside, such as from a restaurant (3% of responses). The second and third reasons are too much portion and overcooking (24% of responses), and not finished by a family member (19,1% of responses).

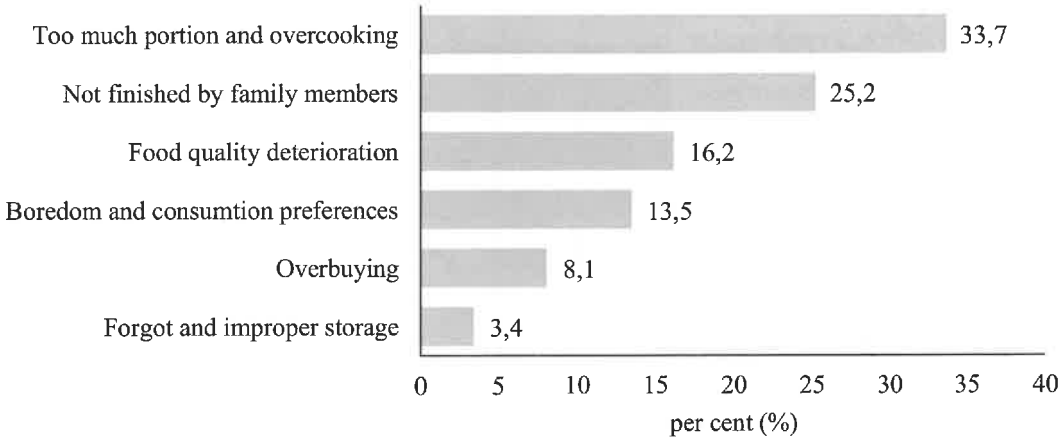


Sources: author's own elaboration based on the survey.

Figure 9. Reasons for Household Waste from Fish as a Percentage of All Responses (n=350)

According to Table 4, meat and beef are the fourth-largest contributors to household waste, expressed in grams per day and per week. The amount of daily household waste is 35 grams. The data indicate that the largest portion of this waste consists of food leftovers from plates, pots, or pans. This suggests that most waste in this category originates from cooked food that is not fully consumed.

Figure 10 presents the percentage distribution of reasons for food waste in meat and beef category. Most respondents eat chicken, and the second most popular option is beef. The price of chicken meat is lower than that of beef, leading respondents to prefer purchasing chicken meat. The most frequent reason for meat and beef waste is too much portion and overcooking (33.7% of responses), while the least frequent reason is forgetting to consume and improper storage (3.4% of responses). The second and third reasons are not finished by family members, including leftovers by children (25.2% of responses) and food quality deterioration, including spoiled, damaged, smelly, and texture-changed food (16.2% of responses).

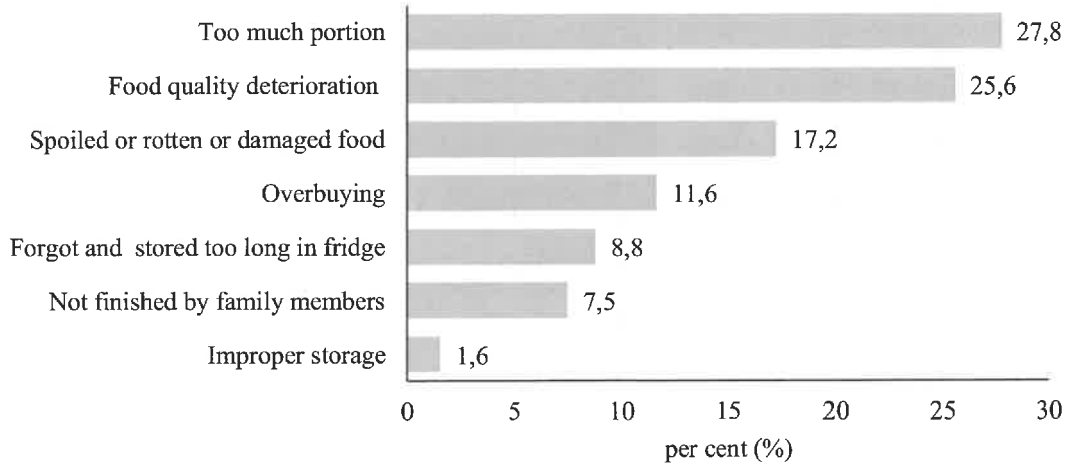


Sources: author's own elaboration based on the survey.

Figure 10. Reasons for Household Waste from Meat And Beef as a Percentage of All Responses (n=350)

According to Table 4, fresh fruit is the fifth-largest contributor to household waste, expressed in grams per day and per week. The amount of daily household waste is 26 grams. Amount of household waste from fruits, including oranges, melons, mangoes, papayas, bananas, watermelons, and apples. The most common types of waste in this category are leftovers discarded after storage, such as fruit that was stored but not consumed, and partly used items, such as half an apple that is not incorporated into a dish. These patterns indicate that fruit waste primarily arises from incomplete consumption and storage practices in households.

Figure 11 presents the percentage distribution of reasons for food waste in the fresh fruit category. The most frequent reason for fresh fruit being wasted is too much portion (27.8% of responses), while the least frequent reason is improper storage (1.6% of responses). The second and third reasons are food quality deterioration, including a change in texture, colour, and shape (25.6% of responses), and spoiled, rotten, or damaged food (17.2% of responses).

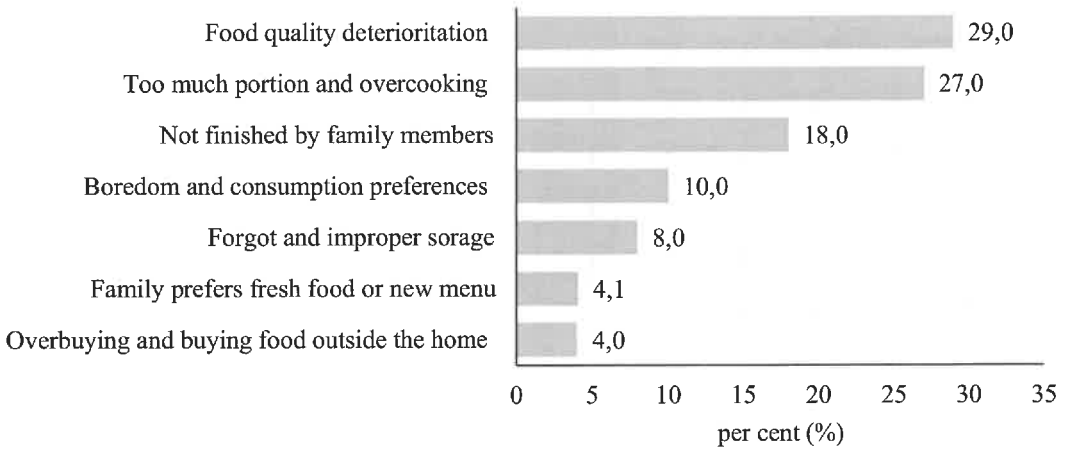


Sources: author's own elaboration based on the survey.

Figure 11. Reasons for Household Waste from Fresh Fruits as a Percentage of All Responses (n=350)

According to Table 4, fresh vegetables are the sixth-largest contributor to household waste, expressed in grams per day and per week. The amount of daily household waste is 20 grams. The data indicate that the largest portion of this waste consists of food leftovers from plates, pots, or pans. This suggests that most waste in this category originates from fresh vegetables that is not fully consumed. There are various kinds of fresh vegetables, such as spinach, water spinach, mustard, cabbage, bean sprouts, pumpkin, celery, and eggplant.

Figure 12 presents the percentage distribution of reasons for food waste in fresh vegetables. The most frequent reason for fresh vegetables being wasted is deterioration in food quality, including spoiled, smelly, quickly spoiling, damaged food, texture changes, past the best-before date (29% of responses), while the least frequent reason is overbuying and buying food outside the home (4% of responses). The second and third reasons are too much portions (27% of responses) and not finished by family members, including some family members who do not finish, children's leftovers, plate leftovers, and not accustomed to eating leftovers (18% of responses).

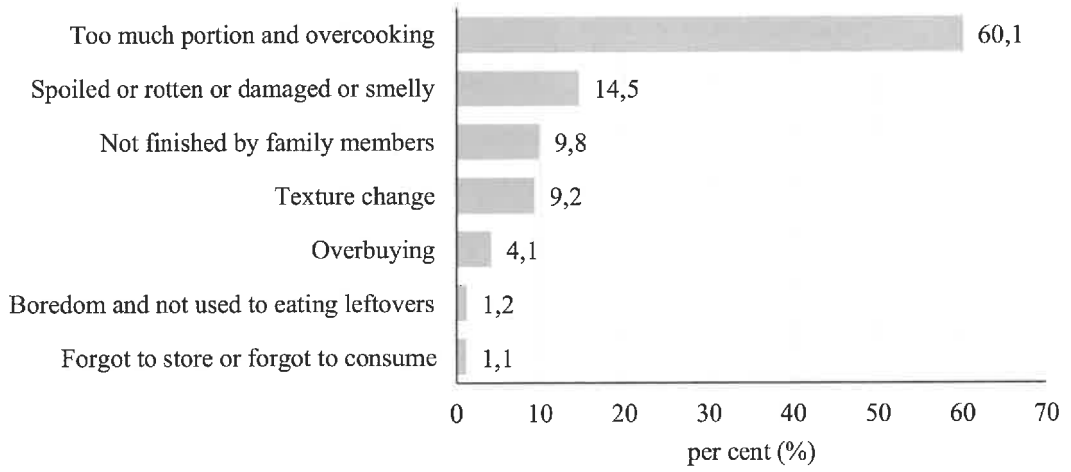


Sources: author's own elaboration based on the survey.

Figure 12. Reasons for Household Waste from Fresh Vegetables as a Percentage of All Responses (n=350)

According to the table 4, rice is the seventh-largest contributor to household waste, expressed in grams per day and per week. The amount of daily household waste is 19 grams. The data indicate that the largest portion of this waste consists of leftovers from plates, pots, or pans, suggesting that most of this waste originates from cooked rice that is not fully consumed. A common reason for this waste is that households often cook rice in excess, resulting in portions that cannot be consumed the following day.

Figure 13 presents the percentage distribution of reasons for food waste in the rice category. The most frequent reason for rice being wasted is taking a portion that is too much and overcooking (60.1% of responses). They are unable to determine the appropriate portion to meet their needs, particularly concerning their family members. Large portion sizes encourage overconsumption and food waste, especially when families are unable to finish their meals (Robinson et al., 2022). This trend of large portion sizes is widely observed and is a major driver of household food waste (Robinson et al., 2022). The least frequent reason is forgetting to store or consume (1.1% of responses). The second and third reasons are spoiled or rotten or damaged, or smelly (14.5% of responses), and not finished by family members, including some family members who do not finish, children's leftovers, plate leftovers, and not accustomed to eating leftovers (9.8% of responses).

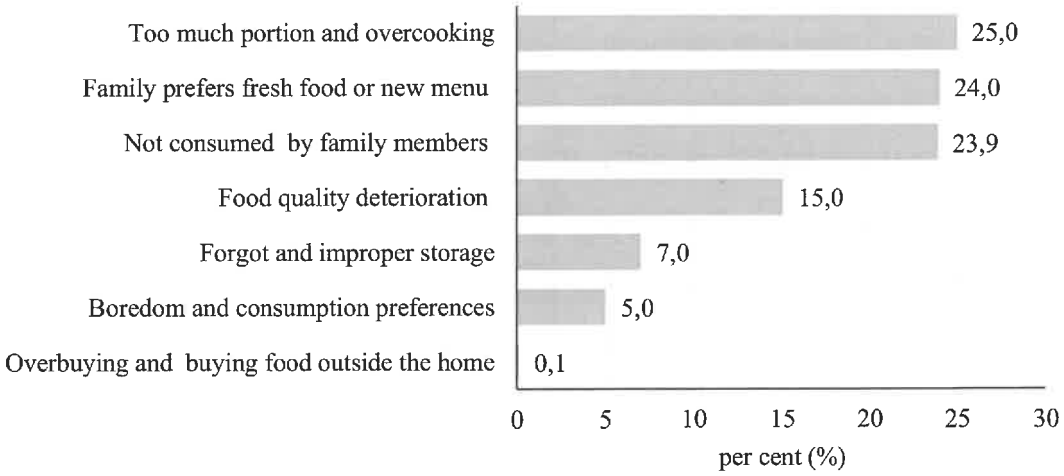


Sources: author's own elaboration based on the survey.

Figure 13. Reasons for Household Waste from Rice as a Percentage of all Responses (n=350)

According to Table 4, non-fresh vegetables are the eighth-largest contributor to household waste, expressed in grams per day and per week. The amount of daily household waste is 19 grams. The data indicate that the largest portion of this waste consists of food leftovers from plates, pots, or pans. This suggests that most waste in this category originates from food that is not fully consumed.

Figure 14 presents the percentage distribution of reasons for food waste in non-fresh vegetables. The most frequent reason for non-fresh vegetables being wasted is taking a portion that is too much and overcooking (25% of responses). The least frequent reason is overbuying and buying food outside the home (0.1% of responses). The second and third reasons are that families prefer fresh food or a new menu including fresh food/single-meal cooking, leafy vegetables have a short time span, and buying fresh vegetables (24% of responses), and not consumed by family members, such as children's leftovers, food remnants, and not accustomed to eating leftovers (23.9% of responses).

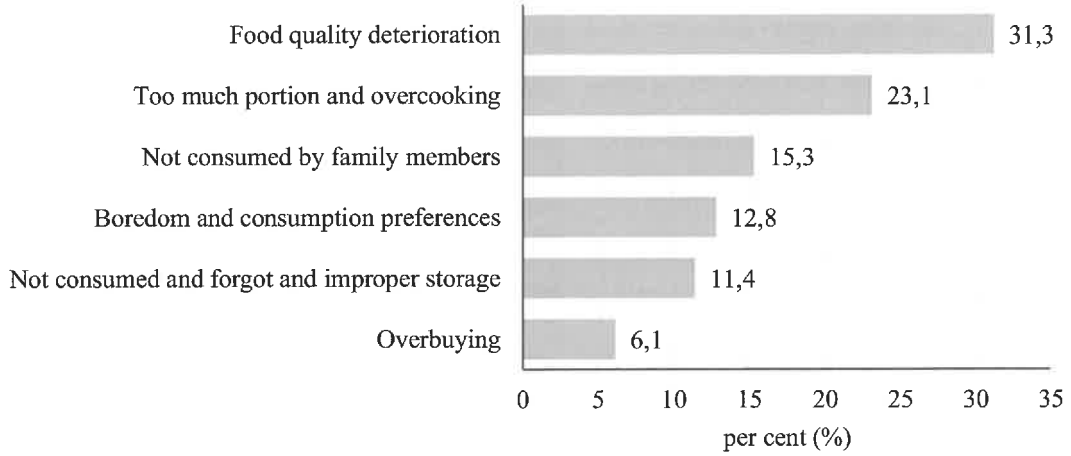


Sources: author's own elaboration based on the survey.

Figure 14. Reasons for Household Waste from Non-Fresh Vegetables (jar /food canned/frozen) as a Percentage of All Responses (n=350)

According to Table 4, cereals, tubers, and their derivatives are the ninth-largest contributors to household waste, expressed in grams per day and per week. The amount of daily household waste is 16 grams. The data indicate that the largest portion of this waste consists of food leftovers from plates, pots, or pans. This suggests that most waste in this category originates from cooked food that is not fully consumed, offering valuable insights into household food waste patterns

Figure 15 presents the percentage distribution of reasons for food waste in cereals, tubers, and their derivative. The most frequent reason cereals are wasted is deterioration in food quality (31.3% of responses). The least frequent reason is overbuying (6.1% of responses). The second and third reasons are too much portion (23.1% of responses), and not consumed by family members, such as children's leftovers, food remnants, and not accustomed to eating leftovers (15.3% of responses).

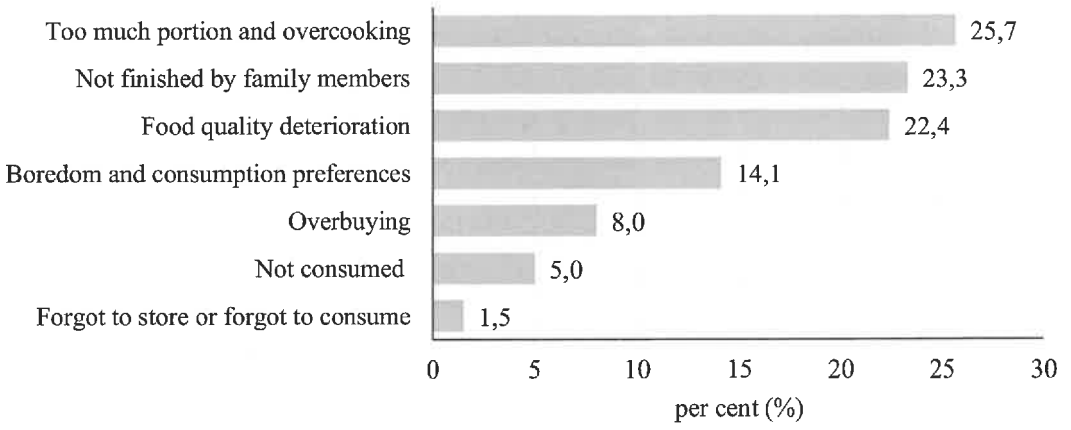


Sources: author's own elaboration based on the survey.

Figure 15. Reasons for Household Waste from Cereals, Tubers, and Their Derivative, as a Percentage of All Responses (n=350)

According to Table 4, beans, lentils, and chickpeas are the tenth-largest contributors to household waste, expressed in grams per day and per week. The amount of daily household waste is 16 grams. The data indicate that the largest portion of this waste consists of food leftovers from plates, pots, or pans. This suggests that most waste in this category originates from cooked food that is not fully consumed.

Figure 16 presents the percentage distribution of reasons for food waste in the bean category. The most frequent reasons beans, lentils, and chickpeas are wasted are taking too large a portion and overcooking (25.7% of responses). The least frequent reason is forgetting to store or forgetting to consume (1.5% of responses). The second and third reasons are not finished by family members, such as children's leftovers, food remnants, and not accustomed to eating leftovers (23.3% of responses), and food quality deterioration, including spoiled, bad smell, texture changes, quickly perishable, past the best before date leftovers (22.4% of responses).

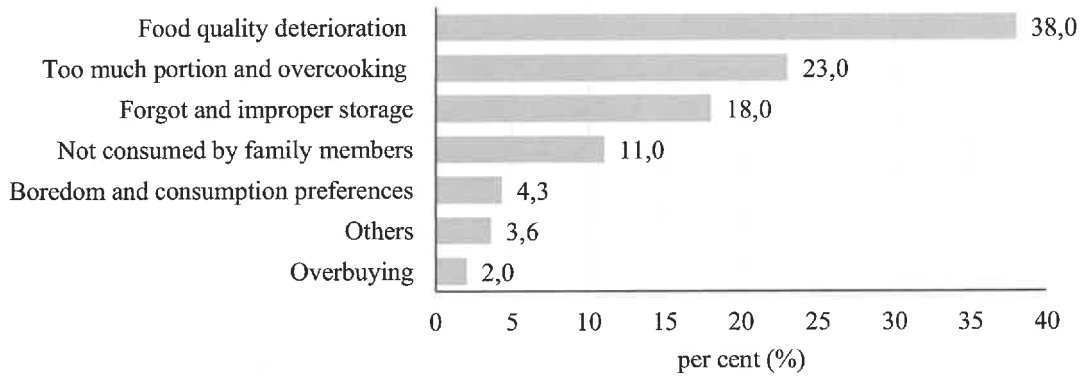


Sources: author's own elaboration based on the survey.

Figure 16. Reasons for Household Waste from Beans, Lentils, Chickpeas, etc., as a Percentage of All Responses (n=350)

According to Table 4, sauces (ketchup, mayonnaise, cocktail sauce, etc.) are the eleventh-largest contributors to household waste, expressed in grams per day and per week. The amount of daily household waste is 13 grams. The most common type of waste in this category is leftovers discarded after storage, indicating that unused or partially consumed packaged sauce contributes to overall household food waste.

Figure 17 presents the percentage distribution of reasons for food waste in the sauce category. The most frequent reason for sauce (ketchup, mayonnaise, cocktail sauce, etc.) is food quality deterioration, including spoiled or expired products, bad smell, texture changes (lumpy/sticky), colour changes, and past 'best before' dates (38% of responses). The least frequent reason is overbuying (2% of responses). The second and third reasons are too much portion and overcooking (23% of responses), and forgetting and improper storage (18% of responses). In the case of this food waste category, 3.6% of the respondents also indicated 'other' reasons. They commented that the children ate messily and spoiled leftovers.

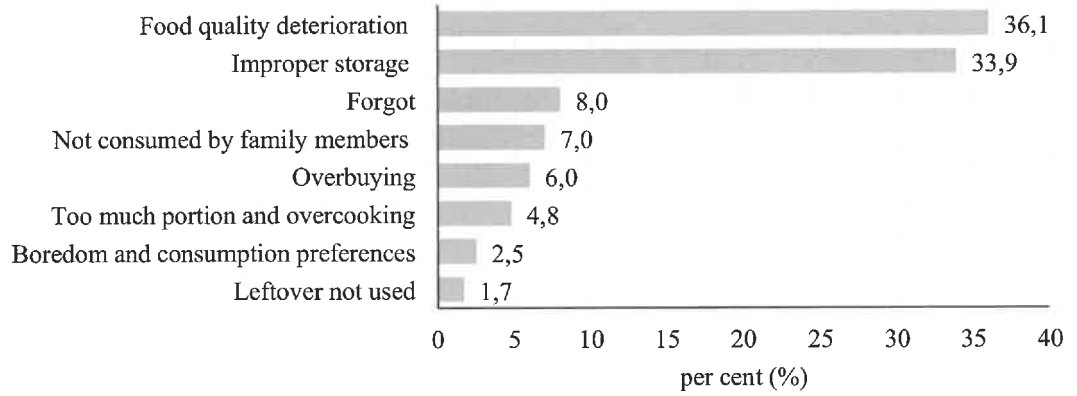


Sources: author's own elaboration based on the survey.

Figure 17. Reasons for Household Waste from Sauces (ketchup, mayonnaise, cocktail sauce, etc. as a Percentage of All Responses (n=350)

According to Table 4, seasoning is the twelfth-largest contributor to household waste, expressed in grams per day and per week. The amount of daily household waste is 10 grams. The data indicate that this waste primarily consists of leftover seasonings or meal components that are discarded after storage, highlighting a tendency for unused or partially used seasonings to contribute to overall household food waste.

Figure 18 presents the percentage distribution of reasons for food waste in the seasoning category. The most frequent reason for seasoning is food quality deterioration, including spoiled, rotten, bad smell, moldy, texture/colour changes, expired, and quickly perishable (36,1% of responses). The least frequent reason is leftover not used (1.7% of responses). The second and third reasons are improper storage (33.9% of responses), and forgetting to consume (8% of responses).

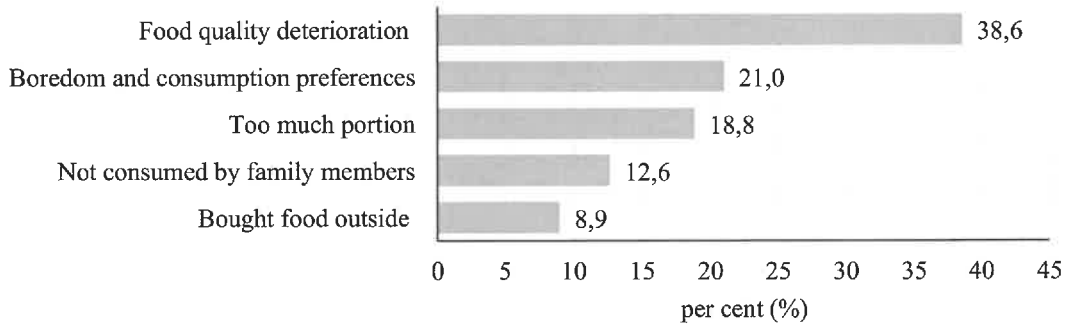


Sources: author's own elaboration based on the survey.

Figure 18. Reasons for Household Waste from Seasoning as a Percentage of All Responses (n=350)

According to Table 4, egg is the thirteenth-largest contributor to household waste, expressed in grams per day and per week. The amount of daily household waste is 10 grams. The data indicate that the largest portion of this waste consists of food leftovers from plates, pots, or pans. This suggests that most waste in this category originates from cooked food that is not fully consumed.

Figure 19 presents the percentage distribution of reasons for food waste in the egg category. The most frequent reason for egg is deterioration in food quality, including spoiled, rotten, smelly, or perishable foods, as well as texture changes (38,6% of responses). The least frequent reason is buying food outside (8,9% of responses). The second reason is boredom and consumption preference, such as boredom with the same food, dislike of certain parts (egg yolk) (21% of responses). Some respondents state that their children don't like egg yolk. It is also one of the causes of leftover food on their plate. The smell of egg influences their dietary preferences and forgetting to consume. The third reason is too much portion (18,8% of responses).



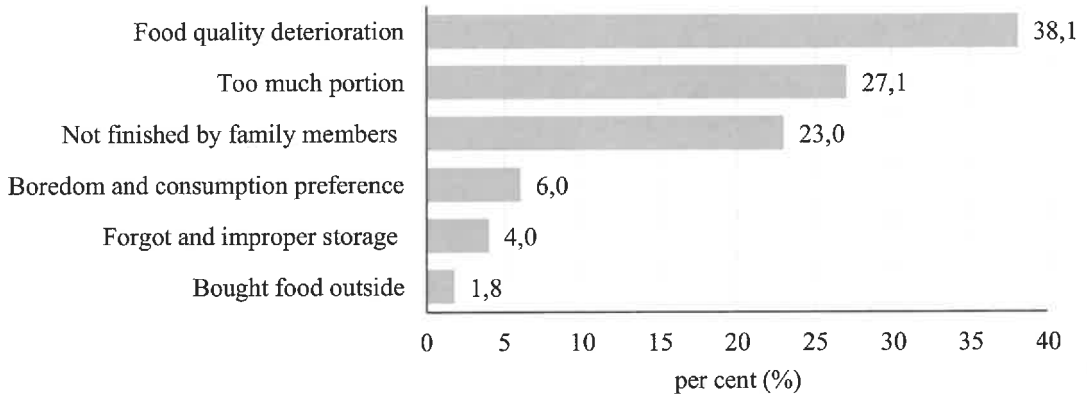
Sources: author's own elaboration based on the survey.

Figure 19. Reasons for Household Waste from Egg as a Percentage of All Responses (n=350)

According to Table 4, bread is the fourteenth-largest contributor to household waste, expressed in grams per day and per week. The amount of daily household waste is 9 grams. The most common type of waste in this category consists of leftovers discarded after storage, reflecting the disposal of unused or partially consumed products. In the Indonesian context, rice is the staple food, and bread is consumed relatively infrequently, which explains the comparatively low amount of bread waste.

Figure 20 presents the percentage distribution of reasons for food waste in the bread category. The most frequent reason for bread is food quality deterioration,

including spoiled, expired, moldy, perishable, texture changed, and smelly (38.1% of responses). The least common reason is buying food outside (1.8% of responses). The second and third reasons are too much portion (27.1% of responses), and not finished by a family member, including some family members who did not finish, children's leftovers, not consumed (23% of responses). As previously noted, Indonesians predominantly prefer rice as their staple food over bread. Bread is typically purchased as a supplementary item and subsequently stored. This reflects the strong relationship between Indonesian culture and rice as the main staple of the dietary habit, while bread plays only a secondary role in eating habits or is merely a complement (Wijaya, 2019).



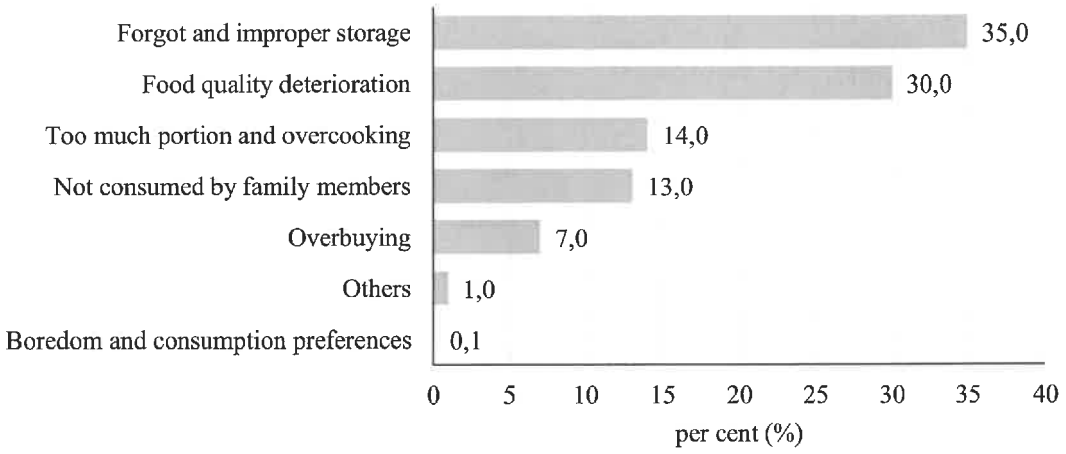
Sources: author's own elaboration based on the survey.

Figure 20. Reasons for Household Waste from Bread as a Percentage of All Responses (n=350)

According to Table 4, sweet and savory snacks (candy/cookies/granola bars/chocolate bars/crisps/nuts/chocolate) are the smallest contributors to household waste, expressed in grams per day and per week. The amount of daily household waste is 5 grams. The most common type of waste in this category is leftovers discarded after storage, indicating that unused or partially consumed packaged snacks contribute to overall household food waste.

Figure 21 presents the percentage distribution of reasons for food waste in the sweet and savory snacks category. The most consumed types in this category are cookies and chips. The most frequent reason for sweet and savory is forgot and improper storage (35% of responses). The least reason is boredom and consumption preferences (0.1% of responses). The second and third reasons are food quality deterioration (30% of responses), and too much portions and overcooking (14% of responses). In case of this

food waste category, 0.1% of the respondents also indicated 'other' reasons. They commented that the children ate messily and spoiled leftovers.



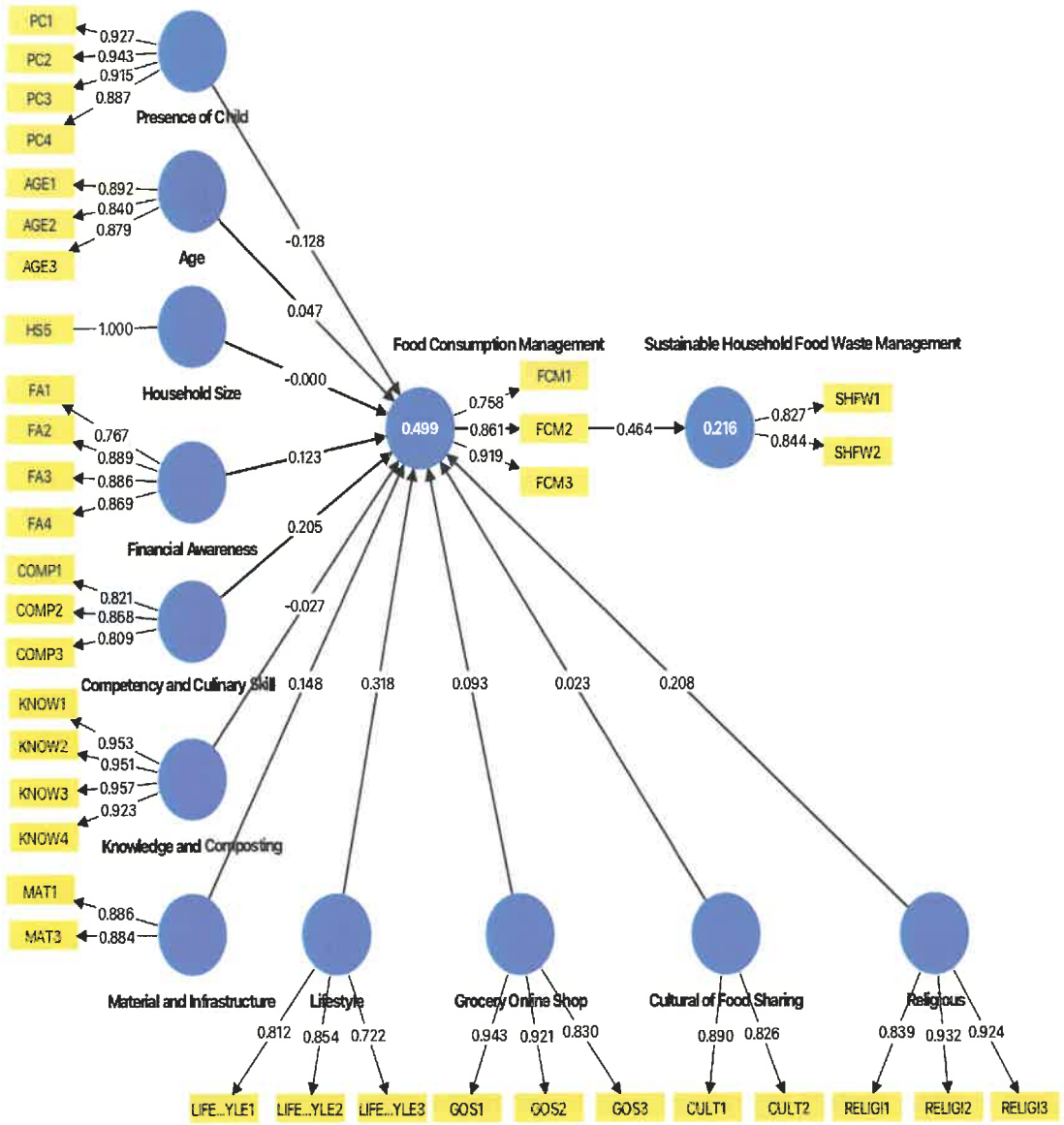
Sources: author's own elaboration based on the survey.

Figure 21. Reasons for Household Waste from Sweet And Savory Snacks as a Percentage of All Responses (n=350)

5.3 Results of SEM – PLS analysis

SEM Analysis in this study employed 13 latent variables that were divided into three groups: the first is socio-demographics, including the presence of a child, age, household size, and financial awareness. The second is Practice Theory, including competency and culinary skill, knowledge and composting, material, and infrastructure. The third is urban context, including lifestyle, online grocery shopping, culture of food sharing, and religion. Those variables examine the influence on food consumption management and sustainable household food waste management. There are two assessments in SEM-PLS, namely: (1) Assessment Evaluation on Reflective Outer Model, (2) Assessment Evaluation on Reflective Inner Model.

At the beginning, outer model testing criteria were carried out. An improvement evaluation was conducted by examining the coefficients of the latent variables relative to their indicators. Coefficient values below 0.7 must be removed from the model. The reflective outer model assessment is done by comparing the loading values with their standard values. The omission process for indicators below the standard value is performed periodically. Figure 22 presents the outer model after examining the indicator value.



Source: Author's own elaboration based on the survey.

Figure 22. Reflective outer model after examining the indicator value

Items of measurement and their reliability for the reflective model

Table 5 shows the value of indicators for each latent variable. In the early outer model, variable presence of child has 4 indicators, age has 3 indicators, household size has 5 indicators, financial awareness has 4 indicators, competency and culinary skills has 3 indicators, knowledge of food planning and composting has 4 indicators, material and proper infrastructure has 3 indicators, healthy lifestyle has 3 indicators, online grocery shopping has 3 indicators, cultural food sharing has 2 indicators, religion has 3 indicators, food consumption management has 3 indicators, and sustainable household food waste

management has 3 indicators. After processing the data, the indicators that were not reliable, i.e. their value was <0.7, were removed. Some indicators of variables were changed: household size (1 indicator), material and infrastructure (2 indicators), and sustainable household food waste management (2 indicators).

Table 5. Latent Variables and Their Measurement Items with the Value of Factor Loading

Latent Constructs	Item Code	Measurements Item	Factor Loadings
Presence of Child	PC1	Since I have had children, I cannot handle the food consumption management in my family.	0.927
	PC2	Since we have had children, I cannot handle the leftover food in my family.	0.943
	PC3	Since we have had children, I often face challenging to maintain the food management in my family.	0.915
	PC4	Since we have had children, nothing changed in our food management.	0.887
Age	AGE1	We don't have ability to manage food consumption effectively.	0.892
	AGE2	We are less concerned about the quantity and quality of food that we consume.	0.840
	AGE3	We tend to generate food waste.	0.879
Household Size	HS1	We do not plan meals.	Dropped
	HS2	We do not purchase the right quantities of food.	Dropped
	HS3	We do not store food properly.	Dropped
	HS4	We often produce food waste in our household due to spoilage, leftovers, or expired products.	Dropped
	HS5	We have irregular meal times and often skips meals, and so the food that was prepared is uneaten and eventually wasted.	1
Financial Awareness	FA1	We avoid spending too much money on food.	0.767
	FA2	We spend money on food based on our desires rather than our actual needs.	0.889
	FA3	We buy food when we see something that we like, even if we have enough food at home.	0.886
	FA4	We plan our food purchases and consumption more efficiently, avoiding overbuying and ensuring that we use up the food we	0.869

Latent Constructs	Item Code	Measurements Item	Factor Loadings
		have, thus reducing the amount of food that gets thrown away.	
Competency and Culinary Skill	COMP1	We have good food consumption management because we have competency and culinary skills.	0.821
	COMP2	We tend to reduce the household food waste because we have competency and culinary skills.	0.868
	COMP3	We serve the food as the family needs because we have competency and culinary skills.	0.809
Knowledge and Composting	KNOW1	We generate lesser of household food waste because we have knowledge of food planning.	0.953
	KNOW2	We cook and serve the food as our family's need because we have knowledge of food planning.	0.951
	KNOW3	We use our food planning knowledge to reduce the climate impact of food waste.	0.957
	KNOW4	We use our knowledge and practice of composting to show that we are aware of environmental concerns.	0.923
Material and Infrastructure	MAT1	We have proper material and infrastructure, such as refrigerator to help reduce the household food waste.	0.,886
	MAT2	We have proper material and infrastructure, to help for food storage.	Dropped
	MAT3	We have good kitchen equipment to improve our ability in maintaining food consumption effectively (planning meals ahead of time, properly storing food in the refrigerator, and composting leftovers to minimize waste).	0.884
A healthy Lifestyle	LIFESTYLE1	We focus on our family's food consumption patterns because we prioritize a healthy lifestyle.	0.812
	LIFESTYLE2	We focus on the quality and quantity of food in our family because we prioritize a healthy lifestyle.	0.854
	LIFESTYLE3	We have better food planning, food processing, and food consumption serving because we prioritize a healthy lifestyle.	0.722
Grocery Online Shop	GOS1	We buy the food online according to the shopping list planning .	0.943
	GOS2	We do impulsive buying when we buy food online.	0.921

Latent Constructs	Item Code	Measurements Item	Factor Loadings
	GOS3	If I buy food online, it reduces the over-buying.	0.830
Culture of Food Sharing	CULT1	We share food with others because it reduces the household food waste.	0.890
	CULT2	We share food with others to avoid unnecessary waste and promote sustainability.	0.826
Religion	RELIGI1	Our religion teaches me how to have better food consumption management indirectly, such as I should have food planning before shopping or I must serve food as family need.	0.839
	RELIGI2	Our religion teaches not to waste the food.	0.932
	RELIGI3	Our religion teaches me to have better food consumption serving.	0.924
Food Consumption Management	FCM1	We make a food shopping list to reduce food waste because we care about minimizing waste and disposing of it in an eco-friendly way.	0.758
	FCM2	We process food efficiently to reduce household food waste because we care about minimizing waste and disposing of it in an eco-friendly way.	0.861
	FCM3	We serve food consumption according to the family's needs because we care about minimizing waste and disposing of it in an eco-friendly way.	0.919
Sustainable Household Food Waste Management	SHFW1	We reduce household food waste by obtaining more information on the environmental, economic, and social impacts caused by food waste.	0.827
	SHFW2	We reduce household food waste by being willing to use the leftover.	0.844
	SHFW3	We reduce household food waste by separating food and non-food waste right from the source (at the household level).	Dropped

Source: author's own elaboration based on the survey.

Assessment Evaluation on Reflective Outer Model

There are some assessments in outer model evaluation in SEM-PLS. There are Cronbach's alpha, Composite Reliability, and Average Variance Extracted (AVE).

Table 6. Assessment Evaluation on Reflective Outer Model

Variable	Cronbach Alpha	Composite Reliability	Average Variance Extracted (AVE)
Presence of Child	0.939	0.956	0.843
Age	0.841	0.848	0.758
Household Size	1.000	1.000	1.000
Financial Awareness	0.881	0.926	0.729
Competency and Culinary Skill	0.779	0.779	0.694
Knowledge and Composting	0.961	0969	0.895
Material and Infrastructure	0.723	0.723	0.783
Lifestyle	0.712	0.718	0.637
Grocery Online Shopping	0.887	0.994	0.809
Culture of Food Sharing	0.647	0.666	0.737
Religion	0.883	0.922	0.808
Food Consumption Management	0.803	0.815	0.720
Sustainable Household Food Waste Management	0.568	0.569	0.698

Notes:

Cronbach's alpha: A good model has a value above 0.7

Composite Reliability: Values above 0.7

AVE: Value above > 0.5

Source: author's own elaboration based on the survey.

According to Table 6, most of the variables have values above the standard. Cronbach's alpha indicates the construct is reliable. There are only two variables below the standard, but still have good enough values (culture of sharing: 0.647; Sustainable Household Food Waste Management: 0.568). Composite reliability indicates internal stability and consistency of the latent variable indicators are excellent. Most variables have values above the standard; only two are below it (Culture of Sharing: 0.666; Sustainable Household Food Waste Management: 0.569). Average Variance Extracted (AVE) indicates that the model is valid. Validity is also a standard measure to show accuracy. All variables have values above the standard, indicating the model is accurate.

Assessment Evaluation on Reflective Inner Model

Inner-model assessment was used to examine the relationships among the model's latent variables. Table 7 presents the value of the inner model of this study. There are some values, including the sample mean, standard deviation, effect size f^2, and P-value. Effect size f^2 assesses the impact of each predictor on an endogenous construct. Evaluation of $f2$ value is based on Cohen (1998). Latent variable predictor effect ranges from weak (0.02), moderate (0.15), and substantial (0.35). According to the result, the effects of the presence of a child, age, household size, financial awareness, competency and culinary skill, knowledge and composting, material and infrastructure, lifestyle, grocery online shopping, cultural food sharing, and religions on food consumption management belong to the small category. It means that all variables mentioned above contribute only modestly to explaining food consumption management. The effect of food consumption management on sustainable household food waste management belongs to the moderate category. It means that food consumption management has contributed moderately to sustainable household food waste management. This study uses bootstrapping to determine if the path coefficients are statistically significant (p-value < 0.05 or 5% significance level). There are 8 significant hypotheses and 4 non-significant hypotheses.

Table 7. Assessment Evaluation on the Reflective Inner model, including Sample Mean, Standard Deviation, Effect Size f2, and p-value.

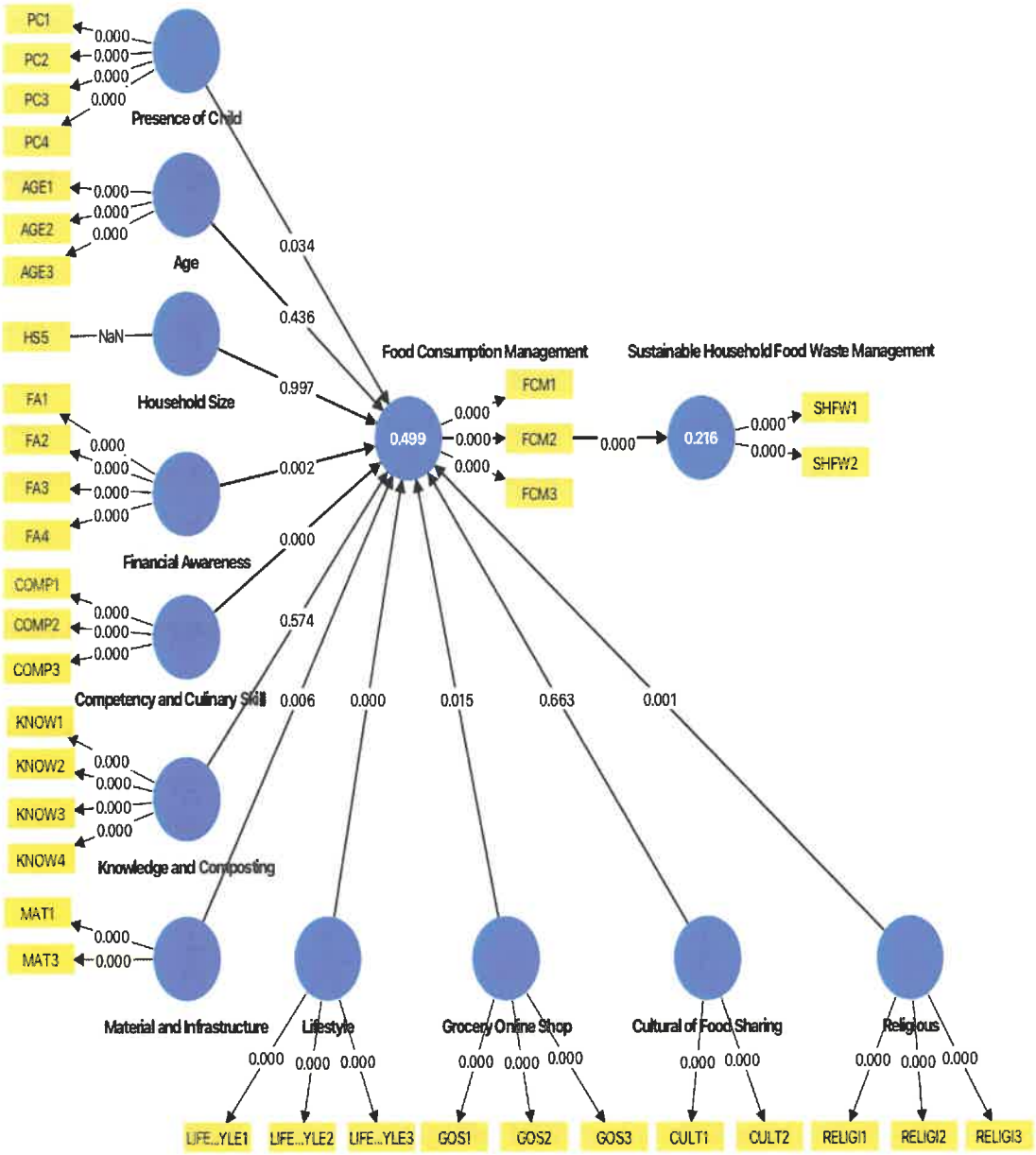
Specification	Sample Mean (M)	Standard Deviation (STDEV)	Effect size f^2	P-Value	Hypothesis
Presence of Child -> Food Consumption Management	-0.126	0.060	0.015	0.034**	H1: Accepted
Age -> Food Consumption Management	0.037	0.060	0.004	0.436	H2: Rejected
Household Size -> Food Consumption Management	0.004	0.046	0.003	0.997	H3: Rejected
Financial Awareness -> Food Consumption Management	0.127	0.039	0.031	0.002**	H4: Accepted
Competency and Culinary Skill -> Food Consumption Management	0.208	0.056	0.062	0.000***	H5: Accepted

Specification	Sample Mean (M)	Standard Deviation (STDEV)	Effect size f^2	P-Value	Hypothesis
Knowledge and Composting -> Food Consumption Management	-0.032	0.047	0.004	0.574	H6: Rejected
Material and Infrastructure -> Food Consumption Management	0.147	0.054	0.035	0.006**	H7: Accepted
Lifestyle -> Food Consumption Management	0.317	0.056	0.134	0.000***	H8: Accepted
Grocery Online Shopping -> Food Consumption Management	0.096	0.038	0.018	0.015**	H9: Accepted
Culture of Food Sharing -> Food Consumption Management	0.025	0.052	0.004	0.663	H10: Rejected
Religion -> Food Consumption Management	0.203	0.062	0.051	0.001**	H11: Accepted
Food Consumption Management -> Sustainable Household Food Waste Management	0.467	0.059	0.292	0.000***	H12: Accepted

Note: ** <0.05 ; ***<0.001

Source: author's own elaboration based on the survey.

The purpose of R^2 is to measure the extent to which exogenous (independent) variables explain endogenous (dependent) variables. The value R^2 belongs to three categories according to Chin (1998): substantial (0.67), moderate (0.33), and weak (0.19). The R^2 of this model is food consumption management, which belongs to the moderate category 0.499, and sustainable household food waste management, which belongs to the weak category 0.216.



Source: author's own elaboration based on the survey.

Figure 23. Inner Model

Hypothesis 1 (H1) The presence of a child has a direct negative influence on food consumption management.

This finding shows that the presence of a child has a direct negative influence on food consumption management (p-value<0.05). In the early stage, families with more children find it more difficult to manage food consumption and to reduce food waste in their households. The higher demand for food, overbuying, varying preferences among

children, and potential difficulties in meal planning contribute to this issue. In addition, most of the time is spent raising the children.

Hypothesis 2 (H2) Younger age of people has a direct negative influence on food consumption management.

The findings indicate that younger age of individuals does not have a direct negative influence on food consumption management (p-value > 0.05). This suggests that age alone is not a primary factor in food management challenges, and other variables may play a more significant role. Younger people tend to be more attentive to the food they consume, reflecting a growing awareness of healthy, sustainable eating patterns. Consequently, while age is related to food behavior, it is not the sole determinant.

Hypothesis 3 (H3) A bigger household size has a direct negative influence on food consumption management.

The findings show that a bigger household size does not have a direct negative influence on food consumption management (p-value>0.05). A bigger family or group does not directly cause problems with food consumption, meaning other factors (like habits, planning, or financial status) might play a more significant role in how food is managed.

Hypothesis 4 (H4) A financial awareness has a direct positive influence on food consumption management.

This finding reveals that a household with greater financial awareness has better food consumption management (p-value < 0.005). The early stage families plan food purchases and consumption more efficiently, avoiding overbuying and ensuring they use the food they have, reducing food waste.

Hypothesis 5 (H5) Competency and culinary skills have a direct positive influence on food consumption management.

The finding shows that competency and culinary skills positively influence better food consumption management (p-value<0.05). The early stage, families that effectively manage their food needs tend to reduce food waste. Families with culinary skills and competency are more likely to avoid food waste.

Hypothesis 6 (H6) Knowledge of food planning and composting has a direct positive influence on food consumption management.

The finding reveals that knowledge of food planning and composting has no positive influence on better food consumption management (p-value>0.05). In other words, just because someone knows how to plan meals or compost food waste does not mean they will actually manage their food consumption more effectively.

Hypothesis 7 (H7) Material and proper infrastructure have a direct positive influence on food consumption management.

The finding shows that material and proper infrastructure have a direct positive influence on food consumption management (p-value<0.05). Early stage families with sufficient materials and proper infrastructure can better manage food consumption and reduce food waste. They have refrigerators to store food and proper kitchen appliances to enhance their ability to preserve food effectively.

Hypothesis 8 (H8): A healthy lifestyle has a direct positive influence on food consumption management.

A healthy lifestyle has a direct positive influence on food consumption management (p-value<0.005). In the early stage of family, attention is on food consumption patterns and the quality and quantity of food they eat. They have better food planning, processing, and food consumption presentation because they prioritize a healthy lifestyle and manage food consumption more effectively to reduce food waste.

Hypothesis 9 (H9) Grocery shopping online has a positive influence on food consumption management.

This finding shows that grocery shopping online has a direct positive influence on food consumption management (p-value<0.05). In the early stage, families who buy food online believe they can avoid overbuying because they purchase groceries according to their shopping list. Most respondents (67%) did their grocery shopping online. They did grocery shopping online due to more practices, saving time, and making it easier. Most respondents frequently shop online, with some doing online grocery shopping more than 10 times a month.

Hypothesis 10 (H10) Culture of food sharing has a direct positive influence on food consumption management.

The findings show that the culture of food sharing does not show a positive influence on food consumption management (p-value>0.05). Food sharing might be expected to reduce waste or improve food distribution, but the findings suggest that it does not have a clear positive effect. This could be because shared food is sometimes wasted, not properly planned, or leads to overconsumption. In fact, the respondents are well prepared to share their food. They consider others' portions when managing their food consumption. While sharing food is intuitively assumed to reduce waste and improve food distribution, empirical evidence suggests it does not always improve food consumption management.

Hypothesis 11 (H11) Religion has a direct positive influence on food consumption management.

This finding reveals that religion is one of the variables that positively influence on food consumption management (p-value<0.05). The religion emphasizes the importance of not wasting food, which is considered a valuable resource that should be used wisely. Religion also promotes mindful eating habits, such as moderation, gratitude, and sharing with others.

Hypothesis 12 (H12) Food consumption management has a direct positive influence on sustainable household food waste management.

This finding shows that households that emphasize efficient food consumption are more likely to engage in sustainable food waste management (p-value<0.05). They significantly reduce waste by carefully planning meals, purchasing only what is needed, and storing food properly.

6. Discussion

Based on the descriptive analysis, most respondents were married couples in the working age range, with husbands predominantly aged 33–40 and wives aged 26–32. The majority of couples had been married for 5–10 years. Most of the respondents have 1–2 children, reflecting adherence to Indonesia's national family planning program. This program aims to control the population in Indonesia and to increase family welfare. There is a trend showing the relationship between declining fertility rates and a decline in the number of marriages in Indonesia. Kosasih et al. (2025) state that this phenomenon is influenced by several factors, including rising age at first marriage, higher educational attainment, and increased female labor force participation.

This study further reveals a demographic shift in the early stages of family formation, characterized by the predominance of older ages among spouses, approaching the young mature phase. This study also indicates that the dominance of wives in managing food consumption (83%) aligns with social and cultural norms that place women as the primary managers of domestic affairs, including food management. Several studies show that women tend to be more involved in household work and caregiving than men, thereby establishing their dominant position in household food management (Lake et al., 2006; Knudsen & Waerness, 2007; Renzella et al., 2020).

Households of most respondents consist of 3-4 member (88%). Mulyo et al. (2025) state that the number of families in Indonesia was a significant factor influencing food consumption management, beginning from provisioning, storage, and disposal. In addition, a large amount of food waste occurred in one, three, and four-person households compared to households with two persons. This is due to the differences in preferences and consumption needs among people (Yu & Jaenicke, 2020; Heng & House, 2021). The number of family members is linked to the number of children in the early stages of the family. In the early stages of a family, spouses typically have a small family, and several factors are considered when determining the appropriate household size for newlyweds. Two important factors that influence the household size are social and economic factors (Tok et al., 2025). It relates to the shift in the age of marriage. Most respondents consistently prioritize economic factors, such as financial stability, income, healthcare expenses, and educational fees. Additionally, social factors, including the wife's educational attainment, her labor-market prominence, and lifestyle considerations, are taken into account. From an economic perspective, several indicators are closely associated with household

food consumption management, particularly household income and expenditure patterns. Household expenditures can generally be categorized into food and non-food expenses. Economic theory suggests that as household income increases, the proportion of expenditure allocated to non-food items tends to rise, reflecting the prior fulfilment of basic needs, especially food consumption.

In this study, the majority of respondents are classified as aspiring middle class and middle class. According to the World Bank, in Indonesia, the aspiring middle class has expenses per capita between USD 3.2 – 7.75 per day, while the middle class has expenses of USD 7.75 – 38 per day. Most respondents in this study have expenses between USD 3.9 – 10.2 per day. They allocate nearly half of their total income to food expenditure. This relatively high proportion suggests that food remains a primary component of household budgeting. Such a pattern is consistent with Engel's Law, which posits that as household income increases, the proportion of income devoted to food declines, although absolute food expenditure may continue to rise. Furthermore, the observed expenditure structure indicates that a substantial share of household resources is still allocated to meeting essential consumption needs, suggesting that young families in the sample are positioned within the middle class level in the Indonesian context. This interpretation is supported by national statistics from the Indonesian Statistics Centre (BPS), which report that, on average, Indonesian households allocate a slightly larger share of total expenditure to food than to non-food items. Thus, the expenditure pattern observed in this study appears broadly consistent with national consumption trends.

Summing up on the demographic profile of this study, the majority of respondents are in the early stage of family level and have children. This group represents a household structure that has received relatively limited attention in the food waste literature, particularly in emerging urban contexts. Previous studies have predominantly focused on households in general or on young consumers as individual units of analysis, rather than examining food waste behavior within families at the family level in the early stages. However, this life stage is particularly important, as the presence of children may influence food purchasing, preparation, and consumption patterns, potentially affecting the quantity and types of food wasted. Therefore, investigating food waste behavior in households at this stage contributes to addressing an important gap in the existing literature and is a novelty of this study.

Further this study estimates food waste by 15 food categories ingrams per day: (1) cereals, tubers and their derivative (2) seasoning (3) beverages (milk, juice, soda.

excluded: water, tea, coffee, diluted syrup) (4) sweet and savory snacks (5) soup/curry (6) sauce (ketchup, mayonnaise, cocktail sauce, et cetera) (7) egg (8) bread (9) fish (10) meat, beef (11) beans, lentils, chickpeas, et cetera (12) rice (13) fresh fruit (14) non-fresh vegetables (jar /food canned/frozen) (15) fresh vegetables. The results of food waste indicate that food categories such as soup/curry, fish, and meat are the largest contributors to waste. The main causes of this waste are excessive portion sizes, the habit of purchasing food in bulk, and a lack of awareness of proper storage and consumption. Mostly food waste from leftovers on plates, cooking utensils, and storage indicates the need for changes in household consumption habits and food management to reduce waste. Other reasons for food waste are the deterioration in food quality, such as spoilage, changes in texture, bad smells, and expired dates. In addition, the majority of respondents tend to overbuy food and prepare portion sizes that exceed their household's actual needs, contributing to a mismatch between food acquisition and family consumption requirements. The amount of quantity of food waste by category was calculated to identify which types of food contribute the largest proportion to overall waste and to explore the underlying reasons.

This study examines a conceptual model of sustainable household food waste management, focusing on the roles of sociodemographic factors, Practice Theory, and urban characteristics in shaping food consumption management and promoting sustainable household food waste practices. The results of the SEM-PLS model confirm that several factors, including financial awareness, culinary competence and skills, adequate availability of materials and infrastructure, a healthy lifestyle, online grocery shopping, and religious values, positively contribute to improving efficient food planning, purchasing, storage, and utilization, thereby reducing food waste.

The findings of this research reveal that the presence of children in a household negatively impacts food consumption management, resulting in food waste. This is related to increased food needs, varied child preferences, and challenges in effective menu planning, which can lead to overpurchasing and food waste. These findings confirm hypothesis 1. The direct interviews reveal that children often pressure parents, leading to overbuying within the household. Their selective eating habits and frequently changing preferences result in over-preparation and over-provisioning of food, which generates more leftovers and waste. This challenge is particularly pronounced in families with many children, where diverse tastes further complicate meal planning and inventory management. Parents often describe children as 'quiet powerhouses' who influence

household food decisions, underscoring the importance of involving them in strategies to reduce food waste. Educational campaigns specifically tailored to children's food behaviors, when combined with active parental involvement, have shown potential to mitigate waste and improve food management practices. These findings indicate that children play a dual role: they contribute to food waste through their consumption and preference patterns, yet they also represent a valuable opportunity for intervention and positive change if effectively engaged. This finding aligns with Kansal et al. (2022), who found that families with more children encounter substantial challenges in managing food consumption efficiently due to higher demand, varied preferences, overbuying, and time constraints associated with childcare. Addressing these challenges requires targeted, culturally sensitive strategies that recognize children's influence on household food decisions and aim to reduce waste while enhancing management efficiency. However, the study by Kansal refers to the general population, while the findings of this study address a gap in the literature by showing that the presence of a child significantly influences food consumption management in the early stage of family life in urban areas, where there is a lack of literature or similar studies on this topic.

The other socio-demographic factor in this study is age and household size. The findings indicate that neither age nor household size has a significant direct influence on food consumption management, suggesting that other variables such as habits, planning behavior, and economic conditions may play a more important role in shaping household food management practices. Therefore, hypotheses 2 and 3 are not supported. Previous research supports the notion that food choices among younger populations, such as adolescents and young adults, are shaped by a complex interplay of personal preferences, family influences, peer pressure, and educational interventions. For instance, developmental differences affect how children and adolescents understand the factors that influence their food choices. Adolescents, in particular, often exhibit greater autonomy from parental control and heightened awareness of healthy eating practices (Fitzgerald et al., 2010). This increased autonomy corresponds with a stronger concern for food quality, indicating that young people actively consider what they consume.

Moreover, school-based interventions targeting younger populations have demonstrated effectiveness in promoting healthier dietary behaviors and attitudes. Such programs often focus on environmental or systemic approaches to diet, highlighting the role of external factors in shaping food management (Chaudhary et al., 2020). Chaudhary et al. (2020) state that while young individuals are receptive to initiatives aimed at

improving food management, multiple other factors beyond age contribute to food-related decision-making and behavior. Furthermore, socioeconomic, cultural, and family context factors also play significant roles in shaping young people's consumption patterns. Parental involvement, family meal practices, and cultural background strongly influence food choices, suggesting that social and family contexts are key determinants beyond individual age (Halicka et al., 2021; Bargiota et al., 2013; Nemeth et al., 2019). Peer influence and eating habits outside the home are also associated with increased consumption of unhealthy foods, highlighting the importance of external environmental factors in influencing food management (Bargiota et al., 2013). Furthermore, young populations may be more susceptible to changes in eating behavior triggered by emotional and situational factors, such as those observed during the COVID-19 pandemic. However, these changes are not always negative and can include positive shifts toward healthier eating patterns (Bühlmeier et al., 2022).

Overall, the findings of this research suggest that food consumption management is not shaped by a single factor only. In addition, this study also focuses on families in the early stage of family life, while demographic trends in Indonesia indicate a shift toward older age at marriage among husbands and wives. This change may affect household consumption patterns and food management decision-making. And this can also be the reason why there are significant differences between the findings of this study and the above mentioned studies by other authors.

In line with other studies, this study confirms that household size does not always have a significant direct impact on food consumption management. For example, larger households are not automatically associated with poorer consumption patterns or increased food insecurity. Household size is rarely the primary determinant of consumption behavior or food insecurity. In Mudzi district, Zimbabwe, household size influenced dietary diversity and food access scores, factors such as the household leader's education, labor availability, livestock ownership, and access to market information were found to significantly influence food security, highlighting the complex interaction between household size and other socioeconomic conditions (Mango et al., 2014). Studies in Ethiopia also show that although larger households are at higher risk of food insecurity, factors such as low income, limited land size, and lack of education are key determinants, emphasizing the mediating role of socioeconomic conditions in the relationship between household size and food security (Mulugeta et al., 2018). The findings of this study also align with the previous research conducted by Mutlu & Gracia (2006), Nayga & Capps

(1994), that the effects of household size are complex and depend on other factors such as employment status, income, and time constraints, which collectively influence food consumption choices and management. This study focuses on early-stage families in urban areas. Households in urban areas of Indonesia, regardless of their size, often rely on convenience-oriented food solutions, such as ready-to-eat meals and food delivery services, which standardize their consumption needs. Moreover, policies that improve education, income stability, and access to resources are more effective at strengthening household food management than those that focus solely on household size. Increased income, land ownership, and membership in social groups improve food security, even in larger households (Nkomoki et al., 2019). Similarly, household adaptation to climate change through strategic planning and resource utilization supports food security, regardless of household size (Rahman et al., 2022).

Food consumption management is influenced by a combination of demographic and socioeconomic factors, including income, household size, and the opportunity cost of women's time. This finding reveals that financial awareness has an influence on food consumption management, which confirms hypothesis 4. The study states that in the early stages of family, they plan food purchases and consumption more efficiently, avoiding overbuying and ensuring that they use up the food they have, thus reducing the amount of food that gets thrown away. This study aligns with prior research showing that socioeconomic, behavioral, and planning factors are more important determinants of food management efficiency. Financial status, education level, planning habits, and labor availability are often key determinants of household consumption outcomes and food security (Mango et al., 2014; Mulugeta et al., 2018). Households with higher levels of financial awareness tend to engage in more deliberate planning of food purchases and consumption, which helps prevent overbuying and promotes the efficient use of available food, thereby reducing food waste. This pattern is consistent with evidence from consumer behavior research indicating that purchasing decisions particularly the avoidance of unnecessary bulk buying play a critical role in determining household food waste volume (Janssens et al., 2019). Effective food purchase planning also serves as an important mediating mechanism through which intentions to reduce waste are translated into improved consumption and leftover management (Panda et al., 2024). Furthermore, the development of responsible consumption behaviors through financial awareness and targeted education strengthens household food management practices by integrating economic considerations with environmental responsibility (Chen, 2019; Chamcham et al.,

2024). And the financial awareness needs to be raised (Potocki & Opolski, 2016). Collectively, these mechanisms generate both economic and environmental benefits by minimizing food waste and enhancing the efficiency of household food resource utilization.

This study also examines the three aspects of Practice Theory, offering novel insights into their role in managing food consumption among early-stage families in the urban setting. While most previous studies investigate this practice in a general context or at the household level, this research specifically focuses on the early stage of the family level, thus contributing a novel aspect to the existing knowledge. The Practice Theory is shaped by the dynamic interaction of embodied skills, practical knowledge, material availability, and the social and cultural meanings attached to cooking and food consumption. This study presents the Practice Theory that involves integration between three elements, namely (1) material and infrastructure, (2) culinary competence and skills, and (3) meaning (knowledge of food planning and composting). Within this framework, practice is not conceptualized merely as individual behavior; rather, it is understood as a socially shared pattern of activities embedded within the household level. These practices structure and shape food consumption management processes, thereby contributing to sustainable household food waste management.

According to the SEM-PLS results, culinary competence and skills have been shown to positively influence more effective food consumption management, ultimately contributing to reduced household food waste, thus confirming hypothesis 5. Early-stage families with culinary skills and competency are more likely to reduce food waste. They tend to use resources efficiently and effectively by applying their culinary skills and competencies. Other studies reveal that adequate culinary skills improve the efficiency of food ingredient use during meal planning, processing, and serving, thereby encouraging waste-prevention practices. In a professional context, individuals with higher cooking competence tend to produce less food waste and exhibit greater awareness of the social, economic, and environmental impacts of food waste, confirming the strategic role of culinary skills in mitigating food waste (Filimonau et al., 2022; Bhaskara et al., 2024). At the household level, families with strong culinary skills are able to better manage food needs in a planned and adaptive way, including determining portion sizes, maintaining food freshness, and optimizing the use of leftovers. Empirical findings indicate that scheduled purchasing practices and cooking skill-based food management contribute significantly to reduced food waste (Teng et al., 2021). Culinary competence increases confidence in kitchen activities, strengthens meal-planning and organizational skills, and

encourages the creative use of leftovers, all of which contribute to more efficient consumption management (Finkelstein et al., 2025). Furthermore, behavioral interventions that support culinary practices, such as planning aids and visual cues, have been shown to be effective in reducing household food waste, particularly among families with established cooking skills (Boulet & Lauren, 2024). Culinary traditions and customs also play a significant role in shaping consumer responses to food and waste management, underscoring that cooking skills are not only technical but also cultural, fostering sustainable consumption patterns (Vargas-Lopez et al., 2021). Culinary competence strengthens food consumption management by enhancing practical skills, improving the efficient use of food resources, and enabling the reduction of avoidable waste. Therefore, families with better cooking skills tend to adopt more effective food management practices and significantly reduce household food waste levels (Filimonau et al., 2022; Teng et al., 2021; Finkelstein et al., 2025). Findings of this study highlight that culinary skills and competencies among early-stage families are key determinants of food preparation, processing, and consumption, ultimately reducing food waste, and provide a novel perspective on sustainable household food practices.

Interestingly, according to the results of this research, knowledge about meal planning and composting did not directly improve food consumption management. Consequently, this study did not confirm hypothesis 6. This suggests that knowledge is not enough to change behavior, necessitating an approach that combines motivation, access to resources, and habit formation that supports sustainable food management. Early stage families are more aware of sustainability issues and possess knowledge about composting. However, this awareness and knowledge are not aligned with attitudes and behaviors. Knowledge related to meal planning and composting must be balanced with lifestyle, habits, and social influences so that this knowledge can be implemented in daily behavior in accordance with the Theory of Planned Behavior. In addition, this study was conducted in urban areas among early-stage families, where most respondents lacked the time to compost or apply their knowledge of meal preparation and composting. The direct interviews also suggest that facilities should be among the considerations. In Indonesia, particularly in urban areas, there is a lack of space for composting and facilities to support it. The study by Clemet et al. (2023) stated that knowledge should be based on one's habits and lifestyle in reducing food waste among young people. Numerous studies have shown that while knowledge about composting and involvement in related programs can increase positive attitudes toward the environment, translating this knowledge into

concrete practices such as efficient consumption planning and food waste reduction is influenced by factors beyond mere cognitive factors (Waliczek et al., 2016). For example, participation in a composting program is associated with improved environmental attitudes and locus of control, but these improvements are not always accompanied by improved practical skills or habits in managing daily food consumption. Furthermore, studies of pro-environmental behavior in the context of food consumption highlight the complexity of adopting sustainable behaviors. Practices such as meal planning, waste reduction, and alternative disposal methods, including composting, tend to vary across individuals, influenced more by demographic and lifestyle characteristics than by knowledge alone (Morais & Ishida, 2024). Although understanding composting techniques such as vermicomposting or pile composting has been shown to be effective in reducing the environmental impact of food waste (Al-Rumaihi et al., 2020; Palaniveloo et al., 2020), these benefits reflect more on technical process efficiencies than on behavioral changes in food purchasing and consumption management. While various composting methods have been shown to contribute significantly to greenhouse gas emission reductions and nutrient recycling, this technical success does not necessarily indicate that individuals with this knowledge consistently apply it in their food consumption decisions. In urban and institutional contexts, effective food waste management practices require a more comprehensive approach, encompassing menu planning, portion control, and redistribution of surplus food, which requires behavioral and systemic changes that cannot be achieved through increased composting knowledge alone (Gonçalves et al., 2023).

Managing food consumption is a multidimensional process that involves the interaction among motivational, behavioral, and contextual factors. Knowledge of meal planning and composting is an important prerequisite, but it is not sufficient on its own to promote more effective consumption management. Therefore, interventions aimed at improving sustainable food consumption practices need to integrate strengthening behavioral motivation, providing access to adequate resources, and developing supportive environmental attitudes and habits, along with knowledge dissemination (Waliczek et al., 2016; Morais & Ishida, 2024).

Summing up, this finding contributes to the practical implication that, in the early stages of families in urban contexts, it is important to provide facilities for handling food waste, such as composting, especially in areas where many early-stage families lack much time.

The finding, confirming hypothesis 7, that the availability of adequate material resources and infrastructure positively impacts better food consumption management is consistent with literature emphasizing the role of household assets in reducing food waste. Households with adequate material facilities, such as refrigerators and appropriate kitchen equipment, are better positioned to preserve food effectively, thereby extending its shelf life and reducing the risk of spoilage. Adequate storage facilities, particularly refrigerators, slow the deterioration process of food, enabling more optimal consumption and supporting more efficient consumption planning. Furthermore, adequate kitchen equipment facilitates safe food processing and storage, thus minimizing waste due to premature spoilage or improper handling practices.

This is in line with other studies that food waste largely stems from inefficiencies at various stages of the food supply chain, including at the consumption stage, where households play a central role. In this context, investment in household infrastructure and materials is crucial because it enables better storage and timely utilization of food. This directly contributes to the sustainability of the food system and to reducing food waste (Ahmadzadeh et al., 2023; Dong et al., 2022). Access to adequate infrastructure also shapes consumer behavior. Households with better storage facilities and equipment tend to be better able to manage food portions and use leftovers, thereby reducing food waste (Ntai et al., 2025). Furthermore, robust household infrastructure supports the development of more sustainable food consumption habits. This infrastructure enables the implementation of food waste reduction strategies, such as reusing leftovers and preserving excess food for later consumption. These practices not only impact consumption efficiency but also provide social, economic, and environmental benefits, including reduced greenhouse gas emissions from food waste decomposition and savings on resources used in food production and distribution (Pour & Makkawi, 2021; Wani et al., 2023). The availability of adequate kitchen materials and infrastructure empowers households to improve food preservation and manage consumption more effectively, thus contributing significantly to reducing food waste. These findings strengthen empirical evidence regarding the importance of infrastructure at the household level in supporting sustainable food systems and reducing food losses at the consumption stage (Ahmadzadeh et al., 2023; Dong et al., 2022; Ntai et al., 2025).

Summing up, the finding of this research also highlights that in urban areas, most early-stage families have the necessary material and infrastructure to support their food consumption management. This contributes to the practical implications that the proper

material and infrastructure are important to reduce food waste among early-stage families, particularly those living in urban areas.

From the perspective of urban context, a healthy lifestyle plays a significant role in improving household food consumption management and, in turn, reducing food waste through more deliberate planning, preparation, and presentation. The early stage of family demonstrates improved food planning, processing, and consumption practices by prioritizing a healthy lifestyle and managing their food more effectively, thereby contributing to the reduction of food waste, which confirms hypothesis 8.

The other studies reveal that healthy eating habits, particularly consuming meals at home, are closely associated with lower food waste intensity, with waste-preventive behaviors acting as a mediating mechanism in this relationship (Savelli et al., 2019). Households that prioritize healthy lifestyles tend to pay closer attention to both the quality and quantity of food they consume, which encourages more careful planning and management and ultimately limits unnecessary waste. In addition to lifestyle-related practices, food waste reduction is also shaped by emotional, cognitive, and financial considerations. Prior research demonstrates that anticipated emotions, heightened environmental awareness, prevailing social norms, and habitual behaviors significantly influence consumers' intentions and actions to reduce, reuse, and recycle food waste (Attiq et al., 2021; Mumtaz et al., 2022).

Food and nutrition literacy further strengthens effective food consumption management. Consumers with higher levels of nutritional knowledge tend to plan grocery purchases more efficiently and generate less food waste, as they are better able to align food acquisition with actual consumption needs and storage capacities. While healthier diets, particularly those rich in fresh fruits and vegetables, may be associated with higher waste potential due to perishability, adequate knowledge and awareness are essential to mitigate this risk and ensure effective food management (Lisciani et al., 2024). Beyond individual household practices, sustainable dietary patterns characterized by reduced consumption of processed and animal-based foods and greater reliance on plant-based options further integrate health and environmental objectives. Such dietary choices contribute to lower energy use, reduced resource demand, and diminished waste generation across the food system (Alsaffar, 2015). When combined with mindful consumption behaviors, these practices enhance household-level food management while supporting broader sustainability goals. A healthy lifestyle improves food consumption management by encouraging intentional selection, preparation, and consumption behaviors. These

practices collectively contribute to reducing household food waste and advancing both environmental sustainability and public health objectives (Savelli et al., 2019; Attiq et al., 2021; Lisciani et al., 2024).

Summing up the findings of this study, households committed to healthy lifestyles often adopt broader value frameworks that reinforce responsible food use and waste minimization. Most early-stage families in urban areas are concerned about a healthy lifestyle, particularly regarding their food consumption management. This study provides novel insights into how their healthy lifestyle practices can effectively reduce household food waste and promote food consumption management.

This study reveals that online grocery shopping influences food consumption management, confirming hypothesis 9. Based on the survey, most early-stage families do online grocery shopping more than 10 times a month. They shop according to the shopping list to avoid overbuying. This finding aligns with the results of previous studies showing that the use of shopping lists in online shopping contexts correlates with lower quantity purchased and total expenditure, reflecting more structured and rational consumption behavior (Davydenko & Peetz, 2020).

In addition to supporting planning, online grocery shopping is also perceived as more practical and time-saving than conventional shopping methods. Perceptions of ease of use, convenience, and time efficiency significantly shape consumers' positive attitudes toward online shopping channels and encourage their frequency of use (Alaimo et al., 2020; Bauerová & Klepek, 2018). In the online shopping behavior model, consumer satisfaction plays a crucial role in building trust, which in turn influences repurchase intentions. While perceived risk remains a consideration especially for shoppers who infrequently shop online more experienced consumers tend to perceive this risk as lower, enabling repeat, stable, and planned purchasing patterns (Mortimer et al., 2016).

During the COVID-19 pandemic, the role of online shopping in managing food consumption has intensified when many consumers shifted to online channels to minimize visits to physical stores. This shift has encouraged more deliberate purchasing decisions, driven by efforts to avoid impulse purchases amid concerns about food shortages, time efficiency, and adherence to health protocols. In this context, online grocery shopping serves as an adaptive strategy that supports more systematic and controlled food consumption management (Chenarides et al., 2020; Wang et al., 2020). Online grocery shopping facilitates better food management through its list-based planning, ease of use, and time efficiency. These factors collectively help households avoid over-purchasing

and support more effective and sustainable consumption practices (Davydenko & Peetz, 2020; Alaimo et al., 2020; Bauerová & Klepek, 2018). This study fills the knowledge gap in the existing literature that advanced technology, particularly online grocery shopping, leads to better food consumption management among early-stage families in urban areas.

Indonesian people have a culture of food sharing. The results of this research proved that the culture of food sharing did not have a significant positive effect on food consumption management. Thus, this study did not confirm hypothesis 10. While sharing is well-intentioned, the practice is often poorly planned and therefore ineffective in reducing waste. Therefore, a culture of sharing needs to be supported by better planning and awareness to impact food waste reduction. According to the survey, in some cases, sharing food actually leads to unintended consequences, such as increased waste due to poor planning or overconsumption. Consumers who engage in sharing practices generally consider others' portion sizes, but this attention does not necessarily lead to reduced overall food waste or more efficient consumption management.

Recent studies confirm that food waste reduction behavior is influenced by various factors beyond the culture of sharing, including emotional, cognitive, and financial aspects. Anticipated guilt and environmental awareness have been shown to play a significant role in driving waste reduction efforts, particularly in the context of restaurant consumption, which is prone to generating substantial food waste (Attiq et al., 2021; Mumtaz et al., 2022). At the household level, barriers such as limited knowledge about food safety and the lack of systematic meal planning often hinder the effectiveness of waste reduction, even when sharing or collective purchasing practices are implemented (Teng et al., 2021). Furthermore, socio-cultural factors can outweigh individual intentions in shaping consumption behavior. Several studies show that religiosity has a limited relationship with food waste-reduction behavior, while certain social norms can actually encourage overconsumption and waste, despite the presence of a sharing culture (Filimonau et al., 2022). Effective food waste management fundamentally requires planned purchasing and consumption behavior, supported by knowledge of food storage and household members' preferences. Without considering these factors, food-sharing practices may lead to overconsumption or the disposal of underutilized surplus food (Teng et al., 2021; Hermanussen et al., 2022). This complexity suggests that even when individuals are willing to share food and consider others' portion sizes, substantial reductions in food

waste can be achieved only through the simultaneous strengthening of habits, emotional motivation, and environmental awareness (Mumtaz et al., 2022).

Food sharing does not automatically improve food consumption management or reduce food waste. Limited planning, potential food waste from shared food, and inconsistent consumption patterns hinder the practice's effectiveness. Therefore, for food sharing to contribute meaningfully to reducing food waste, it must be integrated into a broader strategy that includes careful planning, consumer education, and the formation of sustainable consumption habits (Attiq et al., 2021; Teng et al., 2021; Mumtaz et al., 2022).

Findings of this study prove that religious values exert a positive influence through teachings that emphasize the importance of not wasting food and promoting conscious and moderate eating habits, which confirms hypothesis 11. This aligns with the concept of mindful eating, which increases awareness and responsible management of food consumption. Religions positively influence food consumption management by emphasizing the prohibition of waste and viewing food as a valuable resource that should be used wisely. Most Indonesians are Muslim, and their dietary practices emphasize consuming food according to actual needs, in line with Islamic teachings on moderation and mindful eating.

This study highlights the importance of religions among early-stage families in food consumption management. While previous studies have focused on families in general, this study specifically examines early-stage family life in urban Indonesia, where the majority of the population is Muslim. The study conducted by Monroe (2015) states that moral and cultural perspectives rooted in these religious teachings encourage more conscious eating practices, such as moderation, gratitude, and sharing with others. These values align with the concept of mindful eating, which emphasizes full awareness of the eating experience through sensory engagement without judgment, and attention to internal cues such as hunger and fullness to prevent overconsumption. Miller (2017) also states that this approach helps individuals regulate food intake more effectively and reduce waste by encouraging intentional consumption choices guided by physiological needs rather than automatic habits. Several studies have shown that mindfulness-based interventions aligned with religious teachings on moderation and food management can improve eating regulation and consumption patterns, while reducing disordered eating behaviors (Miller et al., 2013). Mindful eating's emphasis on present-moment awareness and sensitivity to bodily signals complements religious values that emphasize gratitude and respect for food, thus strengthening individuals' motivation to avoid

overconsumption and waste (Keyte et al., 2019). Mindful eating practices are also associated with healthier food choices, lower energy intake, and increased awareness of the value of food, supporting the role of faith-based mindfulness in better food consumption management (Allirot et al., 2017).

Finally, findings of this study confirm that better food consumption management significantly increases awareness and sustainable household food waste management practices, as assumed in hypothesis 12. Early-stage families that implement careful planning, purchase according to needs, and manage food waste through environmentally friendly methods, such as composting or donation, can effectively minimize waste, supporting sustainability and resource-conservation goals. In addition to increasing consumption efficiency, these households also tend to adopt broader environmentally friendly practices. These practices include composting food scraps, creatively reusing leftovers to reduce waste, and donating still-consumable food to prevent unnecessary waste. This combination of actions reflects a holistic, sustainable approach to food management that focuses not only on waste reduction but also on optimizing the use of food resources.

In the international context, the importance of preventing household food waste is emphasized, as consumers are a major source of waste in the food supply chain. Research in Italy shows that interventions that strengthen food management routines, such as better planning and storage, are crucial for achieving the food waste reduction target set in Sustainable Development Goal (SDG) 12.3, which aims to halve food waste by 2030 (Scalvedi & Rossi, 2021). Similarly, households that are efficient in managing their food consumption tend to exhibit behaviors that reduce food inefficiencies, which are strongly correlated with reduced food waste (Smith & Landry, 2020). Previous studies also emphasize that households that adopt waste-prevention practices have the potential to develop long-term sustainable consumption habits. This includes reducing promotional impulse purchases, which often contribute to increased waste, as well as shifting towards more planned, conscious food purchases tailored to the household's actual needs (Ntai et al., 2025). Furthermore, sustainable food waste management integrates proactive approaches, such as meal planning and donation, with reactive solutions, such as composting, to support nutrient recovery and reduce environmental impact (Garcia-Garcia et al., 2016; Dey et al., 2024). Households that emphasize efficiency in food consumption can create a positive cycle of sustainability through behavioral changes and the adoption of practical waste-management methods. These efforts not only help reduce food loss and

waste but also support broader environmental and social goals related to sustainable food systems and resource conservation (Scalvedi & Rossi, 2021; Smith & Landry, 2020; Garcia-Garcia et al., 2016).

Overall, this study emphasizes the importance of a multidimensional approach to managing household food consumption and sustainable household food waste management, encompassing financial awareness, practical skills, cultural of food sharing and religion, and supporting infrastructure. Interventions that integrate these factors can improve food management efficiency and significantly reduce household-level waste. This study makes contributions to the existing literature on sustainable household food waste management among early-stage families in urban areas, a topic that remains underexplored. Most of the previous studies focus on general families or households; this study focuses on early-stage families with the presence of children who have contributed to the food waste generation. This focus provides a novel contribution to the field.

7. Conclusion, Recommendations, and Limitations

7.1 Conclusion

This study examines the relationship between selected socio-demographic factors (presence of children, age, household size, and financial awareness), key elements of Practice Theory (competency and culinary skills, knowledge of food planning and composting, and the availability of materials and appropriate infrastructure), and aspects of the urban context (healthy lifestyle, online grocery shopping, culture of food sharing, and religion) in shaping food consumption management and sustainable household food waste management. Understanding how these factors interact is essential for identifying the drivers of household practices in food purchasing, preparation, consumption, and disposal.

Among the socio-demographic factors, financial awareness plays a particularly important role in improving food consumption management. Households with higher financial awareness tend to demonstrate more efficient food planning, purchasing, storage, and utilization practices, which ultimately contribute to reducing food waste. In contrast, the presence of children shows a negative influence on food consumption management. Households with more children often face greater challenges in managing food consumption due to diverse food preferences, unpredictable eating patterns, and increased food demand, which may lead to over-purchasing and higher levels of food waste. Meanwhile, other socio-demographic variables, namely age and household size, were not found to have a significant influence on food consumption management.

From the perspective of Practice Theory, practical competencies, culinary skills, and material and proper infrastructure also shape household food consumption management behaviors. Culinary competence and culinary skills enable households to prepare meals more efficiently, control portions, and utilize leftovers, thereby supporting more effective food consumption management. Similarly, the availability of appropriate material infrastructure, such as kitchen equipment and adequate storage facilities, facilitates better food preservation and organization, which further contributes to reducing food waste. However, knowledge of food planning and composting was not found to have a significant direct effect on food consumption management. This finding suggests that knowledge alone may not be sufficient to change behavior unless it is accompanied by motivation, habitual practice, and supportive resources that enable the translation of knowledge into everyday actions.

Urban contextual factors also influence household food consumption management practices. Adopting a healthy lifestyle often encourages individuals to manage food more carefully, including paying closer attention to portion sizes, food quality, and balanced diets. Online grocery shopping can also support more efficient food consumption management by allowing households to plan purchases in advance and buy food according to actual needs. In addition, religion positively influences food consumption management by promoting teachings that discourage waste and encourage moderation in consumption. These values align with the principles of mindful eating, which emphasize awareness, gratitude, and responsibility in food consumption.

Nevertheless, not all contextual practices lead to improved sustainable household food waste management. For example, a culture of food sharing does not necessarily reduce food waste when such practices are not well organized or planned. Without clear coordination, food sharing may occur only occasionally or after surplus food has already been generated. Therefore, effective culture of food sharing initiatives requires better planning, community awareness, and supportive systems to ensure surplus food is redistributed efficiently.

Overall, the findings suggest that effective food consumption management plays a significant role in promoting sustainable household food waste management, particularly among early-stage families, a demographic group that has been relatively underexplored in previous studies. Households that engage in careful meal planning, purchase food according to actual needs, and manage leftovers through environmentally friendly practices such as composting or donating surplus food can significantly reduce food waste and support broader sustainability and resource conservation goals. Importantly, the results also highlight that knowledge and intentions alone are insufficient to drive behavioral change. Instead, successful household food waste management requires an integrated and multidimensional approach that combines financial awareness, practical culinary skills, culture of food sharing and religion, supporting infrastructure, motivation, access to resources, and the development of sustainable daily habits.

7.2 **Recommendations**

Research findings indicate that interventions to improve household food consumption management efficiency and reduce waste need to be designed in an integrated manner. These interventions should include increased financial awareness and improved budgeting

practices, the development of practical skills, particularly culinary competencies, and the utilization of culture of food sharing and religion that support food consumption management. Furthermore, the availability of material resources and proper infrastructure is also an important prerequisite for food consumption management practices. This integrated approach has the potential to improve household food consumption management efficiency while significantly reducing food waste, thereby supporting broader sustainability and resource conservation goal.

7.3 Limitations

The study is **restricted to household-level food waste management** and does not cover food waste generated in production, processing, distribution, or commercial food services. Additionally, the findings reflect behaviors and conditions in the early stage of family life and may not fully represent households in later life stages or different cultural contexts. In addition, the sample of the population focuses on Bogor city and Bogor regency, and these areas need to be expanded in future research.

By clearly defining these boundaries, the study provides **focused insights** into household behavior while acknowledging the limits of generalizability. These limitations also highlight opportunities for future research to explore other stages of family life, broader geographic contexts, and other components of the food system.

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Appendix 1. Letter of Consent

INFORMED CONSENT

Setelah mendengar dan memahami penjelasan penelitian, dengan ini saya,

Nama :

No Hp :

menyatakan

SETUJU / TIDAK SETUJU*

Untuk ikut sebagai responden / subjek penelitian dengan judul
"Food Waste at Early Stage of Family in Urban Area: A Case Study of Bogor City and Regency, West Java, Indonesia"

"Sampah Makanan pada tahap awal keluarga di area urban: sebuah studi kasus di Kota Bogor dan Kabupaten Bogor, Jawa Barat, Indonesia" (dalam bahasa Indonesia)

Bogor, ...

Tanda tangan,

(.....)

Saksi:

(.....)

Keterangan:
* coret yang tidak perlu.

Appendix 2. Amount of grams per unit and amount of grams per answer option of the Household Food Waste Questionnaire

Category	Unit	Estimated grams
Fresh vegetables	Serving spoon	50
Non-fresh vegetables	Serving spoon	50
Fresh fruit	Piece	100
Non-fresh fruit	Piece	80
Potatoes	Serving spoon	60
Potato products	10 fries	50
Pasta	Serving spoon	50
Rice	Serving spoon	60
Meat	Portion	150
Fish	Portion	150
Sandwich filling	Portion	20
Bread	Slice	35
Bread	Whole bread	800
Cereals	Portion	40
Cereals	Pack	500
Yoghurt et cetera	Portion	150
Yoghurt et cetera	Pack	1000
Cheese	Cube	10
Eggs	Egg	60
Soups	Ladle	150
Soups	Litre	1000
Sauces	Spoon	20
Sauces	Bottle	450
Candy	Portion	20
Crisps / nuts	Portion	20
Non-alcoholic beverage	Glass	250
Non-alcoholic beverage	Litre	1000
Alcoholic beverage	Beer glass	300
Alcoholic beverage	Litre	1000

Product category	Answer option 1	Answer option 2	Answer option 3	Answer option 4	Answer option 5
Fresh vegetables and salads	25	75	150	250	350
Non-fresh vegetables	25	75	150	250	350
Fresh fruit	25	50	100	300	500
Non-fresh fruit	20	40	80	240	400
Potatoes	25	75	150	250	350
Potato products	25	88	375	750	1125
Pasta	25	75	150	250	350
Rice and remaining grains	25	75	150	250	350
Beans, lentils, chickpeas, et cetera	25	75	150	250	350
Meat	75	150	375	675	900
Meat substitute	45	90	225	405	540
Fish	75	150	375	675	900
Bread toppings	10	20	50	90	120
Bread	18	35	400	800	1200
Cereals	10	40	250	500	1000
Yoghurt, custard, et cetera	38	150	500	1000	2000
Cheese	5	10	20	45	60
Eggs	30	60	150	270	360
Soups / curry	38	150	500	1000	1500
Sauce	10	30	90	225	675
Candy / cookies / bars	10	20	50	90	120
Crisps / nuts	10	20	50	90	120
Non-alcoholic beverages	68	250	500	1000	1500
Alcoholic beverages	75	300	500	1000	1500

Appendix 3. Reasons Why Thrown Away the Food (Guideline for Enumerators)

1. Stale/molded/damaged food
2. Cooking too much
3. Food changes texture (soft/sticky)
4. Food spoils quickly/goes stale (short shelf life)
5. Some family members don't finish their food
6. Forget (food is in the refrigerator too long)
7. Smelly food
8. Food changes color
9. Not storing food properly (inappropriate storage temperature)
10. Family likes fresh food/eating once
11. Tired of eating the same food twice
12. Food past the "best before date"
13. Portions are too large/too many
14. Buying food outside the home so you don't eat food that has been cooked at home
15. Buying too much food
16. Food past the expiration date
17. Not used to eating leftovers (last night or leftovers from previous meals)
18. Others.....