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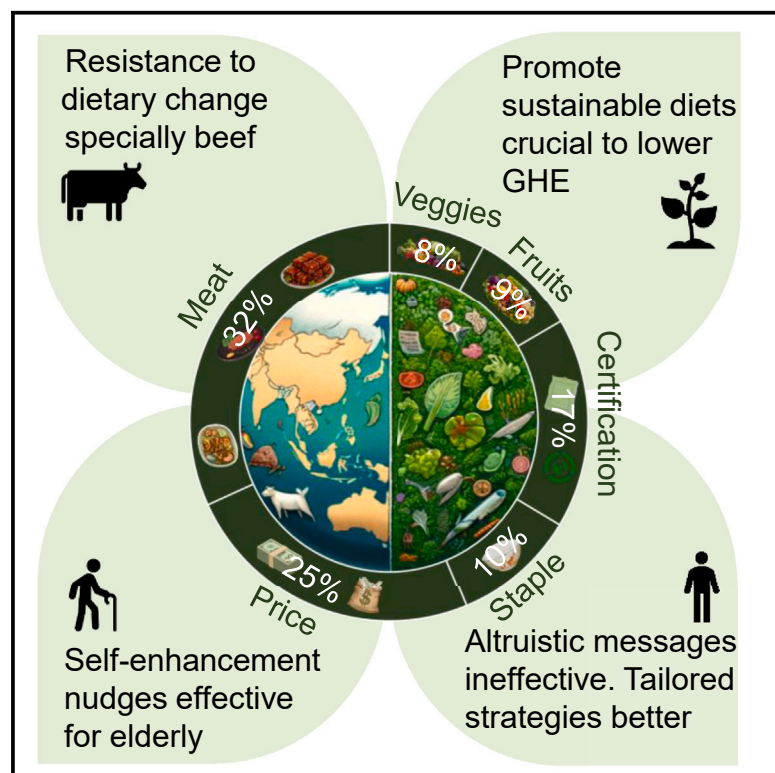
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Cultural and generational factors shape Asians' sustainable food choices: Insights from choice experiments and information nudges

Graphical abstract



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In brief

This global research stresses the critical role of sustainable diets in curbing greenhouse gas emissions and addressing climate change. Examining consumer behavior in China, Japan, and Vietnam uncovers a reluctance to shift from current dietary habits, notably concerning animal proteins. Traditional approaches like altruistic messaging prove ineffective, emphasizing the need for nuanced communication. A promising strategy emerges—framing information in a self-enhancement context, particularly effective with older individuals—providing a potential avenue for successful intervention. The study offers essential insights for policymakers and researchers navigating sustainable diets in Asia.

Highlights

- Promoting sustainable diets is crucial for curbing global greenhouse gas emissions
- Asians resist dietary changes, especially in animal protein consumption
- Altruistic messaging is ineffective; tailored strategies are vital for behavior change
- Framing information as self-enhancement, particularly for elderly, shows promise



Article

Cultural and generational factors shape Asians' sustainable food choices: Insights from choice experiments and information nudges

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SCIENCE FOR SOCIETY This research emphasizes the global importance of promoting sustainable diets as a vital tool in mitigating greenhouse gas emissions and addressing climate change. Conducted across China, Japan, and Vietnam, the study unveils insights into Asian consumer behavior, indicating a widespread reluctance to shift from current dietary habits, especially regarding animal proteins. Traditional methods like altruistic messaging proved ineffective, signaling a need for more targeted communication strategies. However, a promising approach emerges—framing information in a self-enhancement context, notably effective with older individuals—providing a potential path for successful interventions in promoting sustainable food choices. The study not only highlights challenges but also identifies effective strategies, offering valuable guidance for policymakers and researchers engaged in fostering sustainable diets in Asia.

SUMMARY

Promoting sustainable diets is crucial for mitigating global greenhouse gas emissions. We investigated the potential for large-scale dietary shifts to address the impacts of climate change on agriculture and food through surveys and choice experiments in China, Japan, and Vietnam ($n = 5,089$). Our findings reveal that Asian consumers are largely unwilling to deviate from current dietary habits, particularly regarding the consumption of animal proteins. This reluctance persists despite significant preferences for environmental certification as a proxy for greater sustainability in food production, as expressed by wealthier and younger respondents. Information experiments demonstrate that altruistic messaging fails to induce change, and positive information about climate impacts weakens the influence of certification. However, self-enhancement framing, particularly effective with individuals aged 60 years and above, shows promise. Our findings provide valuable insights for researchers and policymakers seeking effective strategies to encourage sustainable diets, shedding light on challenges and potential avenues for successful intervention.



INTRODUCTION

Under the continuing pressure of population growth and socio-economic development, the International Panel on Climate Change (IPCC) Special Report on Climate Change and Land emphasizes the urgent need for a transition to more sustainable and low greenhouse gas (GHG) emission agricultural land-use systems to mitigate climate change. Beyond land management-based response options, the IPCC emphasizes the need for a transition of consumer diets through the shift in demand and food choices in line with public health guidelines that enable sustainable agriculture and support the United Nation's Sustainable Development Goals (SDGs).¹ The IPCC estimates that dietary changes alone could potentially mitigate 0.7–8.0 GtCO₂-equiv year⁻¹ by 2050. The EAT-Lancet Commission echoes the IPCC's call for a shift in human diets and concludes that the changes to healthier diets are interlinked with global efforts to improve environmental outcomes. The World Resources Institute (WRI) also stresses the critical correlation between diets, consumption choices, and the capacity of the environment to support a sustainable food future.² According to the WRI, greater sustainability in resource, land, and water use in agriculture can be achieved only through a transition away from the overconsumption of calories and animal-based proteins, especially those that are resource and GHG emissions-intensive like bovine meats.

Despite their growing populations, rapidly expanding economies, and growing appetite for dietary protein,^{3,4} Asian countries have been underrepresented in the study of strategies to mitigate climate change. This is particularly true for sustainable food futures under climate change.^{5,6} To date, diets across South and East Asia are more in line with sustainable reference diets, especially when compared with North America and Europe⁷ (although Asian diets still fall in undesirable consumption ranges in some categories, particularly red meat). However, the rapid growth in demand for animal proteins, especially among Chinese middle-class consumers, is aggravating already scarce land and water resources in the region⁸ while also contributing to nutritional diseases.^{2,4} Projections by the Organization for Economic Co-operation and Development and the Food and Agriculture Organization of the United Nations (OECD-FAO) suggest that if current trends continue, meat consumption in Vietnam and China will increase by more than 75% and 21% over the respective 2010 levels by the end of the decade. Considering this evidence, evolving food habits across Asia are becoming a driving force in the debate about the consequences of diet choices for climate impacts and efforts toward more sustainable agricultural production systems. However, little empirical evidence exists, to date, on whether Asian consumers are ready to make this shift and what it may look like.⁹

A large body of literature is now dedicated to addressing the complexities of linking climate change, sustainable land and resource use, and human diet behavior. Studies on individual awareness and actions on climate change^{10,11} evaluate interventions to enhance public understanding about the consequences of diet choices for the climate.¹² Many studies investigate how information about the proven health effects of reducing meat consumption,^{13,14} the environmental externalities of livestock agriculture,¹⁵ and the promotion of plant-based diets to mitigate

climate change⁹ that may or not sway mainly Western consumers to change their consumption behaviors. On the issue of land use and food production under climate change, a majority of studies investigate climate-smart adaptation strategies for smallholder farming systems in developing countries, predominantly sub-Saharan Africa, given the key role agriculture plays in the livelihoods and food security of many poorer countries.^{8,16,17}

However, studies that address climate change mitigation strategies with an explicit emphasis on dietary changes are still scarce.^{18–20} Moreover, these studies tend to focus predominantly on Western consumers and their preferences for sustainability attributes in food.^{21,22} Western literature has mainly focused on food labeling and certification schemes (e.g., food miles, CO₂ footprint, sustainable production practices, etc.).^{21,23,24} A separate stream of studies has evaluated consumer acceptance and willingness to pay (WTP) for sustainable food innovations, such as plant-based meats, and the use of unconventional proteins (e.g., insect based).^{9,22} Population-scale studies that formally investigate whether consumers are in fact willing to shift to dietary or meal patterns in line with current recommendations as described by Aiking and de Boer¹⁸ for the benefit of the climate are still lacking.

The objective of this study was, therefore, to investigate Asian consumers' willingness to change dietary patterns with an explicit focus on mitigating climate change and associated negative environmental and health externalities.²⁵ In contrast to previous literature, we are not interested in measuring individual WTP for novel, sustainable foods. Instead, our goal was to quantify whether and to what extent Asian consumers are willing to engage in diet transition to environmentally friendlier sources by choosing food baskets²⁶ with proven benefits in terms of mitigating climate change, land use, and resource intensities. In line with a growing body of literature that uses information treatments to “nudge” human behaviors in the health and/or the environmental space, the choice-experimental approach in this study includes different randomized information treatments (nudges) to test the extent to which information about climate change, negative environmental externalities, or direct health effects of consuming foods from intensive agricultural practices may, in fact, nudge individuals toward adopting a sustainable diet.

Our analysis is based on population-scale survey-experimental data collected from the following three major Asian countries: China, Japan, and Vietnam. These three countries were chosen to encompass a wide range of economic, dietary, and cultural contexts found across Asia.²⁷ The survey aimed to identify the determinants that influence an individual's capacity to transition toward more sustainable dietary choices as a means of addressing climate change. These determinants include environmental health concerns, current food consumption patterns, and environmental awareness. In this context, a sub-sample analysis was employed as a methodological approach to elucidate variations driven by cultural, socio-economic, and generational factors.^{28,29}

To assess dietary preferences and willingness to accept food baskets (diets) associated with varying levels of environmental and agricultural GHG emissions, a food-basket choice

experiment²⁶ was embedded in the survey. As part of the choice-experimental study design, three information nudges were developed and implemented to evaluate the effects of the following three specific factors: (1) the increasing GHG emissions resulting from rising demand for resource-intensive meat products, (2) the pressures of intensive agricultural production practices on natural resources, and (3) the human health impacts associated with the growing use of mineral fertilizers and pesticides in intensive agricultural systems. In addition, the experimental design accounted for individuals' WTP for certified sustainability attributes in food production, which have been linked to perceptions of food quality and safety among Asian consumers.^{24,30} This comprehensive analytical framework allows us to study the roles played by heterogeneity in diet preferences, income effects, and the growing demands for certified environmental assurances in food production within the dietary decisions among Asian consumers. Furthermore, analyzing diet transitions instead of individual food preferences allows quantifying the net benefit of different interventions. In this context, we discovered that most consumers are hesitant to deviate from their current dietary habits. Nonetheless, for certain segments of the population, specific incentives have exhibited significant favorable influence, prompting a transition toward more sustainable food consumption.

RESULTS AND DISCUSSION

To investigate the willingness of Asian consumers to undergo dietary transitions for the purpose of mitigating negative climate and environmental impacts, we conducted large-scale field surveys and embedded discrete choice experiments (DCEs) in China, Japan, and Vietnam.^{31,32} These countries were selected to capture the diverse economic realities, growth paths, and variations in food preferences centered on rice-based dietary habits across Asia. The existence of cross-cultural differences in food preferences has been well-established in the literature.³³ In China, per capita income continues to rise, resulting in a growing demand, especially for pork meat, making it the world's largest consumer of meat.³ However, there is a gradual acceptance of vegetarian diets among Chinese consumers. Vietnam traditionally follows a diet that consists of locally produced fruits and vegetables, with relatively low meat and fish consumption.⁴ However, the country is undergoing a dietary transition characterized by a decrease in vegetable consumption and an increase in demand for meat and dairy products, driven by rapid economic growth.³⁴ Japan stands as one of the most developed economies globally, with a traditional diet centered around the high consumption of fish and soybean products and relatively low consumption of animal proteins.³⁵ By including these three countries in our study, we aim to capture a diverse range of economic, dietary, and cultural contexts prevalent across Asia. This approach allows for a more comprehensive understanding of the factors influencing consumer willingness to adopt dietary changes for both environmental and health-related reasons.

As part of the choice-experimental study design, three information nudges were developed and implemented to examine the impact of information and education regarding the climate (GHG), resource usage, or personal health consequences of inten-

sive food production on respondents' choices of alternative food baskets.^{13,36–38} Before entering the food basket choice experiment, participants were randomly assigned to read one of the three categories (or a control with no information) to test the effects of educational information on participants' food basket choices.¹⁴

Transitioning toward sustainable diets to mitigate climate change comes with a cost, a DCE-enabled analysis of consumer preferences for food baskets at different price levels, from which a WTP for baskets of basic food items with varying degrees of sustainability could be inferred. This novel food basket approach²⁶ is used to evaluate government policy strategies in terms of consumers' demand for individual food items, in accordance with the categories in the study. DCEs are a widely used tool to analyze stated preferences across multi-attribute alternatives to identify and quantify trade-offs in the respondents' decision-making about hypothetical yet relevant food basket composition. We use these data to estimate a latent utility for the consumption of individual food products, using the consumer's stated choices across food baskets. These utilities are used to calculate individual willingness to support a shift toward a sustainable diet, generating empirical evidence of food choice behaviors and the effects that information nudges may have in enticing more sustainable dietary patterns among consumers in the three Asian countries.^{32,39–41}

Aggregate data analysis

The evidence obtained from the analysis of the aggregate choice data shows strong consumer preferences for food baskets with certified environmental credentials, making the sustainability of the foods offered the most sought-after attribute in all three countries (Figure 1A). Consumers were willing to pay (WTP) an extra 15.6% for a food basket if its products were verifiably certified to have been produced sustainably (Tables S2 and S4). Meanwhile, meat, price, and certification are the three most important attributes when consumers choose the food baskets (Figure 1B). Our results are consistent with a large body of literature that finds certification of sustainable food quality to be important to consumers, especially in China and across Asia.⁴² This finding implies that the trust-building properties of independent certification have the potential to facilitate diet changes toward reducing agricultural GHG emissions by rewarding positive environmental change in agriculture via consumer WTP for verifiable sustainable practices.

Our results further suggest that traditional dietary preferences for rice as the staple food in Asia persist, with a WTP of 7.1% (95% confidence interval [CI]: 6.3%–7.9%) over the alternative carbohydrate sources of bread or potatoes. However, it is important to note that rice cultivation consumes more natural resources compared with alternative options. This poses a challenge in terms of sustainability and climate impact, as increased rice consumption requires significant amounts of water and land resources.⁴³ Strategies that aim to reduce the environmental impact of rice cultivation, promote the diversification of carbohydrate sources, or encourage the adoption of more sustainable rice farming practices may be necessary to align dietary preferences with long-term sustainability goals. In addition, Asian consumers are found to be largely unresponsive to substitutions within the fruit and vegetable categories of their food baskets

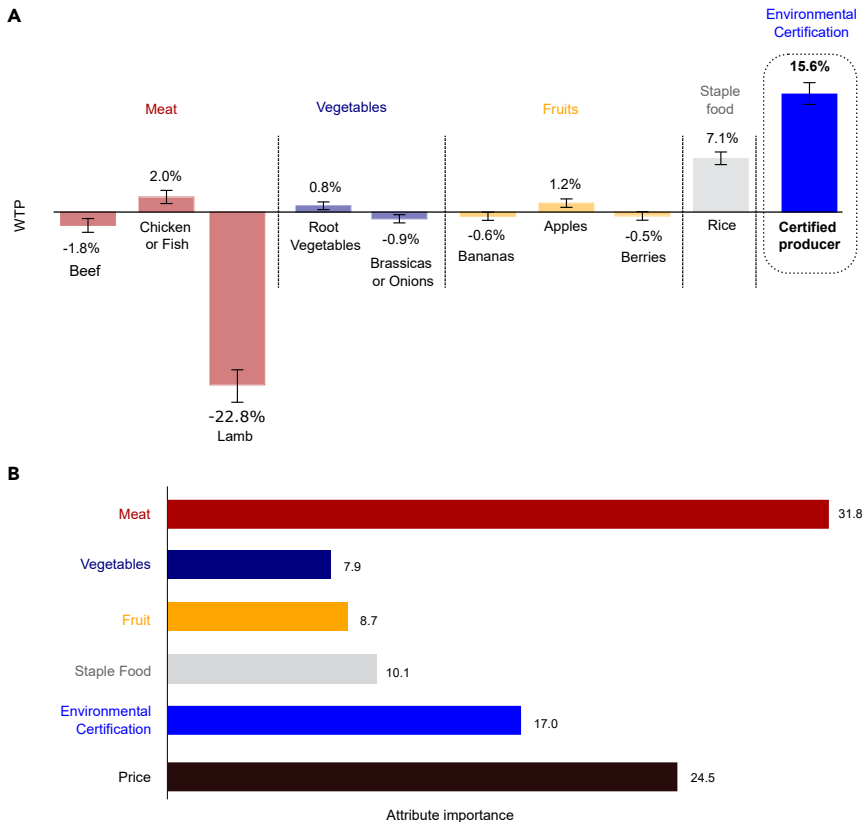


Figure 1. Choice model estimates—aggregate data

(A) Participant WTP for food basket items and environmental certification based on aggregate data. Levels of WTP are relative to status quo food basket items and no certification of food basket. The reference levels of food items are pork, tomatoes, citrus fruits, and potatoes/bread in the meat, vegetable, fruits, and staple food attributes, respectively. In terms of certification, the reference level is not certified.

(B) Aggregate attribute importance normalized across attributes. The error bars indicate 95% confidence intervals.

(Figure 1A). Consumer food basket valuations differed significantly by meat protein, with a significantly higher preference for chicken or fish at 2.0% (95% CI: 1.1%–2.9%) over pork. WTP for beef was -1.8% (95% CI: -2.7% to -0.9%); WTP for lamb was -22.8% (95% CI: -25.1% to -20.8%) measured against the reference of pork (Figure 1A). These findings emphasize the challenge of transitioning toward more sustainable meat options, such as chicken or fish, in Asian countries where a strong preference for pork exists. Traditional dietary preferences, particularly the widespread consumption of pork, pose a significant hurdle in efforts to promote more sustainable and environmentally friendly food choices. Addressing this challenge requires careful consideration of cultural and dietary factors, as well as the development of targeted strategies to encourage a shift toward alternative, sustainable protein sources.

With rising household incomes across Asia, increasing beef consumption has been at the center of the debate over agricultural GHG emissions.^{1,2,20} After accounting for price effects, our results indicate that the majority of Asian consumers do prefer chicken or fish rather than more emission-intensive pork or beef as their protein of choice. Particularly noteworthy is the fact that our model results do not provide statistically robust evidence to support the dominant recommendation for diet transition in the climate change literature—a shift from meat proteins to plant-based diets. This conclusion is based on the lack of statistically significant differences verified by independent tests of food basket attributes (Table S11) and from the analysis of reported food consumption patterns in the survey portion of the study. The data collected

from respondents in the three countries reveal a low preference for plant-based diets. This implies that only a small proportion of participants in the study expressed a strong inclination toward consuming predominantly plant-based foods. The limited number of responses focusing on plant-based diets hinders the ability to perform robust statistical analyses. The lack of correlation between the meat and vegetable attributes suggests that it is very difficult to incentivize consumers to replace meat protein with vegetable counterparts. As rice remains highly starch, we focus the rest of the analysis on meat-type substitution. Our aggregate model results highlight the roles dietary preferences, WTP, and verification of the sustainability properties of food items significantly matter to Asian consumer food basket choices and their profound effects on the GHG emissions of the underlying food system.

Country effects on diet choice

Given the differences in the socio-economic realities in the three study countries, we report food-basket attribute preferences across countries to identify cross-national effects on food demand (Figure 2A), including detailed unweighted country-level analytical results in Figure 2A and Tables S3 and S5. The comparison of country-specific preferences is based on stratified country sampling designed to represent population demographics in terms of age, gender, and household income.^{33,44} The results indicate significant preferences for chicken or fish only among Chinese consumers with a WTP of 9.1% (95% CI: 5.4%–14.1%) over other meat proteins. This finding contrasts with the notion that Chinese consumers' appetite for pork and beef is a major driver of global agricultural GHG emissions. Here, our results indicate that Chinese consumers do value fish and chicken over pork relative to their Vietnamese and Japanese neighbors, which, on average, are considered 30% climate-friendlier than the other meat protein sources.⁴³

Another finding of note across countries is a uniform and significant WTP to price premiums for environmental certification. Vietnamese consumers express the highest WTP at 38.9% (95% CI: 17.1%–198.1%), and Chinese are a close second with a

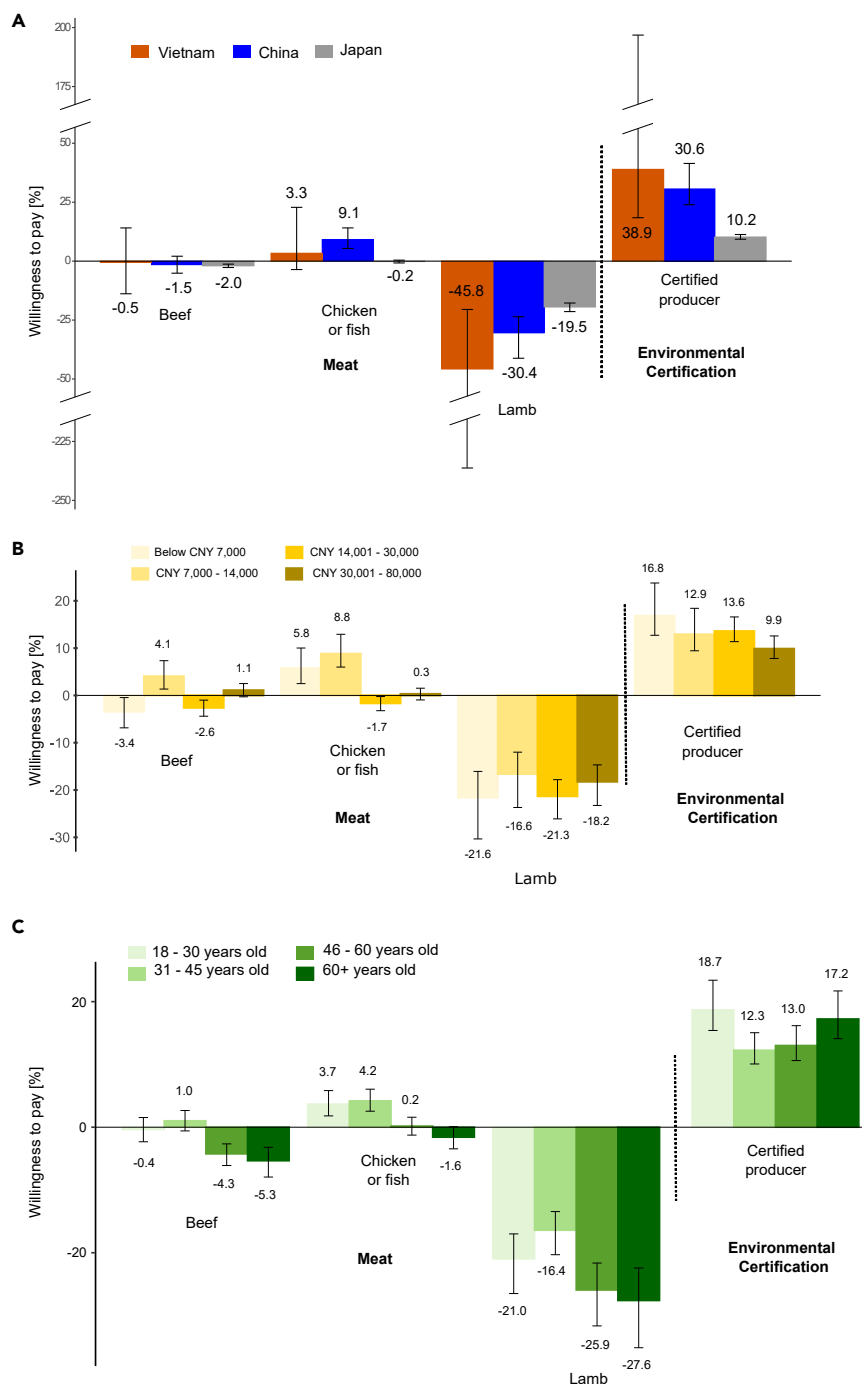


Figure 2. Willingness to pay

(A) WTP for meat protein items and environmental certification by participant country, China, Japan, and Vietnam.

(B) WTP for meat protein and environmental certification by household income segment.

(C) WTP for meat protein and environmental certification by participant age segments. All WTP estimates are relative to status quo protein (pork) and no certification of the food basket. The reference level is pork in the meat attribute. In terms of certification, the reference level is not certified. The error bars indicate 95% confidence intervals.

WTP of 30.6% (95% CI: 23.9%–41.4%) for a certified food basket ahead of Japanese consumers with a WTP at 10.2% (95% CI: 9.3%–11.3%). This result is in line with previous studies reporting growing public concerns over agricultural pollution particularly in China and Vietnam—concerns that drive the demand for certified “green” foods.^{45,46} Preferences and WTP for verified sustainability of food items are supported by participant responses to a survey about the level of trust in important food certification systems (e.g., green food and organic food). Here, the majority of 84% of con-

sumers declared their trust in certified environmental labels. However, the institution granting food certification matters to Asian consumers, with international organizations being the most trusted certifier. In contrast to the previous literature^{42,47} that reported distrust in government-led food certification, our results find that more than 50% of the Vietnamese and Chinese respondents trust government certification schemes for sustainable foods. In comparison, only 26% of Japanese consumers trust their government to verify the environmental credentials of their food supply. This evidence suggests that existing agri-food sustainability-labeling schemes across Asia, which rely on “green food” labeling to mitigate climate change and related agricultural production practices, may lose their anticipated effects on consumer behavior over time and with economic development. However, faced with heterogeneity in food quality across modern and traditional market channels, emerging market consumers may interpret environmental certification as an indicator of superior food quality, safety, and food health—a result previously reported for Chinese consumers.^{45,48}

Effects of income and generational differences on diet transition

The previous literature emphasizes the key roles that growing middle-class incomes and aging populations across Asian economies play in pathways to sustainable diet transitions.^{30,49,50} Besides, the age segments allow for examination of dietary habits as they are formed (18–30), maintained (31–60), and potentially altered due to health or lifestyle changes in later life (60+). By segmenting our study in this way, we are able to capture and compare the diverse dietary patterns across different age demographics. Our results across income segments (Figure 2B) confirm the notion of a positive link between household incomes and preferences for

beef, the luxury meat for many Asian consumers. As expected, lower-income households signal preferences for familiar chicken and fish protein.⁵¹ An overview of WTP results across household income segments is provided in Table S6. The income effect on protein demand, and beef in particular, is mitigated by an opposing effect of respondent age, with those aged 45–60 and >60 years increasingly rejecting beef against the status quo protein of pork (Figure 2C). As such, our results also profile a segment of older Asian consumers expressing preferences for more traditional dietary habits, characterized by a preference for food baskets (diets) containing pork and rice (see Table S7).

In contrast to Vietnam, China and Japan are facing rapid population aging, characterized by a scarcity of households with young children. However, in our data, 48% of Vietnamese and 27% of Chinese respondents are less than 30 years of age. Based on the notion that younger consumers and households with children tend to care more about certified environmental (and health) attributes,^{52–54} our analysis reveals a positive WTP for certification of 18.7% (95% CI: 15.4%–23.4%) among participants in the 18–30 years age group (Figure 2C). This finding suggests that younger generations are increasingly considerate of environmental factors when making food choices. However, findings through the years have been mixed.⁵⁵ Detailed results are presented in Table S7. Overall, our results reveal that respondent age is equally important to household income in affecting Asian consumer preferences for food baskets with certified environmental credentials. As such, this analysis clearly underscores the impacts of income and age effects on dietary preference among Asian consumers that were previously only documented in a Western context.⁵⁶

Strong preferences for assured environmental attributes in food baskets suggest that consumers in lower-income countries such as Vietnam, especially younger consumers, should be the targets for food policy interventions that seek to incentivize diet behaviors consistent with the relevant recommendations. In this context, middle-class households across Asia stand out as a rapidly growing segment; however, they are the least responsive to environmental certification signals. A broad-based positive WTP for environmental certification, motivated by environmental pollution and food safety concerns, could provide a valuable policy tool for Asia to facilitate both dietary and agricultural shifts toward sustainability in the medium term.^{57,58}

Effects of information nudges on diet choice

A growing body of literature that investigates consumption decisions related to issues in health, the environment, and climate change employs experimental methods to elicit the effects of “soft policy interventions” through information and education on individuals’ food preferences and choices.

To the best of our knowledge, our results are among the first to provide cross-national empirical evidence on the effects of sustainability-centered information nudges on food basket choices of Asian consumers.²⁶ Despite consistent positive WTP for environmental certification, we found that information nudges are not an effective tool for shifting consumer choice behavior toward more sustainable diets. In fact, compared with the control group, the provision of nudges—that focused on the effects of resource-intensive agriculture on the natural environment and

the detrimental impacts of current livestock husbandry practices on climate change—reduced treated participants’ WTP for certification of food baskets, despite being consistently positive (Figure 3A). This result points to the role egoistic versus altruistic motives may play in individual decision-making. The notion of egoistic motives in dietary changes is supported by the finding that when negative human health consequences of intensive food production practices were raised, treated participants responded most strongly. However, the level of WTP was not significantly different from the control group (95% CI of WTP difference: –4.5% to 5.9%). A deeper analysis of the effects of information nudges across age groups revealed a significant positive effect of the health-motivated nudge on older participants’ (age 60+ years) WTP for certification at 27.5%, significantly higher than the control group at 13.2% (Figure 3B; Table S9).

Analyzing the effect of information nudges on participants’ WTP for different meat types revealed that food basket choices with less sustainable meat options (e.g., beef and pork) were not discouraged by any of the information treatments. In comparison, chicken and fish were preferred over the control by consumers in the GHG emission and health information treatment groups. WTP for these meat options in the food basket increased by 1.7%–3.7% and 2.8%, respectively. Despite the increase, the difference in WTP was not statistically significant at the 5% level (95% CI of WTP difference between GHG emission and control group: –0.3% to 8.9%; 95% CI of WTP difference between health information and control group: –4.5% to 6.0%). We contend that this outcome could be corroborated with further data collection (see Figure 3A). This asymmetry in the promotion of sustainable food versus the discouragement of less sustainable food products seems to be consistent with examples in the weight loss literature, where the empirical evidence consistently suggests that it is easier to incentivize healthier food behaviors than to discourage unhealthy behaviors.^{59,60} The discouragement of unsustainable food is an ongoing research area. Previous findings related to habits and environmental behavior have shown that for many consumers, the reduction, rather than the exclusion, of meat is a more acceptable message to shift toward more sustainable diets. Other factors also play a vital role in diet transition such as sustainable eating related to healthy diets, accessibility, price, and social influence.⁶¹ However, even addressing food practices with health messages has shown a low impact on a certain group of consumers.⁶² More data are needed to confirm this result in our context, as food certification can be seen as a crude proxy for the food-health nexus.

However, certification for environmentally friendly practices has been shown to affect the perceived utility of food products,⁶³ which we consider the main underlying contributor to the reported findings. Furthermore, GHG emission and health-focused nudges had a higher, positive effect on rural Asian households’ WTP of 22.0% (95% CI: 12.5%–61.7%) and 24.6% (95% CI: 14.0%–69.9%) compared with 15.2% (95% CI: 10.5%–25.0%) in the control group (Figure 3C; Table S10). In contrast, for urban Asian consumers, the information nudges reduced WTP for certification, especially in the GHG emission group of 10.9% compared with the control at 17.7% (Table S8). Previous case studies for China have

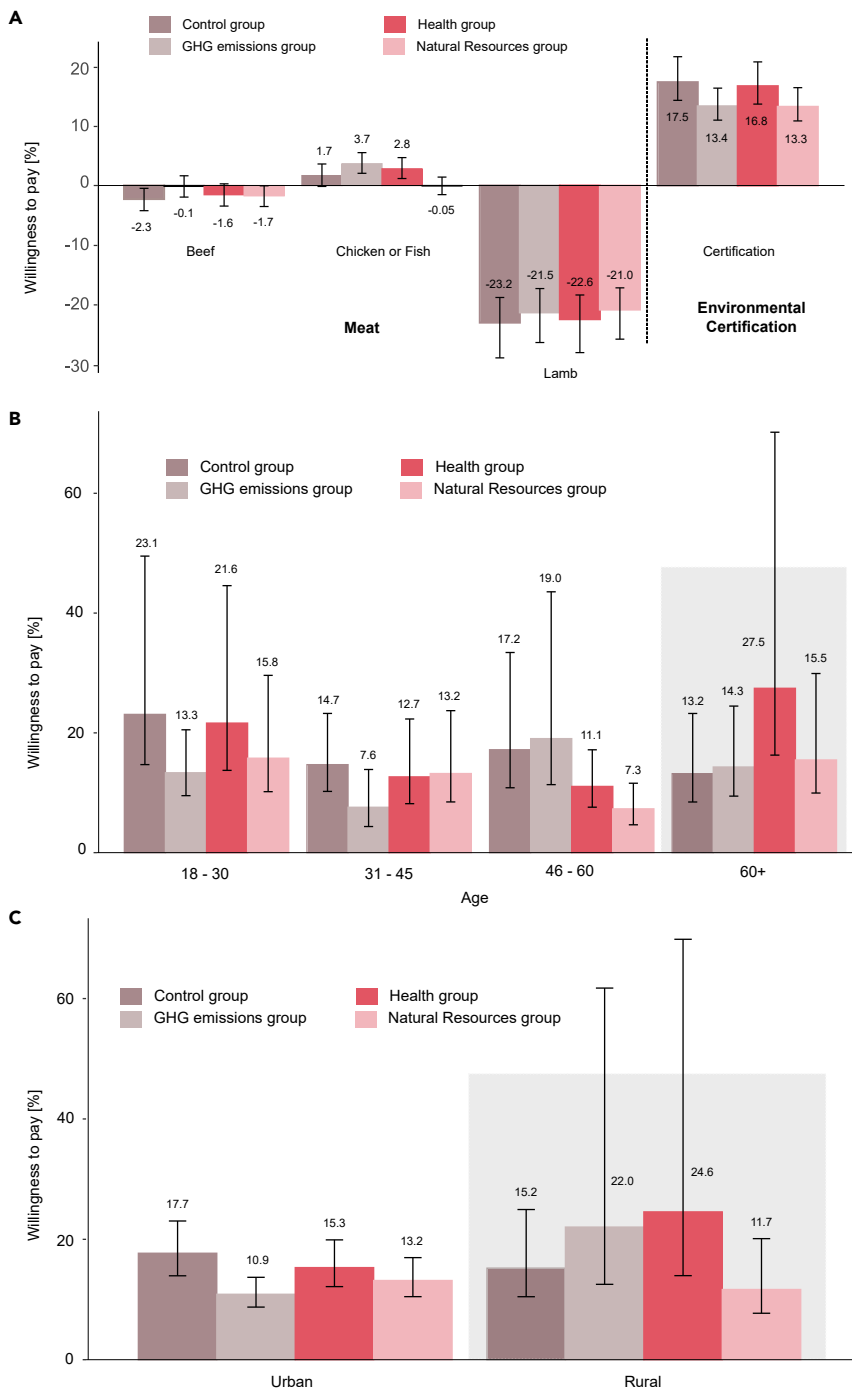


Figure 3. Information treatments

(A) Levels of WTP for meat and environmental certification for all survey participants by information treatment group (GHG emission, health, natural resources, and control).

(B) Levels of WTP for environmental certification by information treatment group (GHG emission, health, natural resources, and control) and participant age segment.

(C) WTP for environmental certification by information treatment group (GHG emission, health, natural resources, and control) and rural/urban location. The reference level is pork in the meat attribute. In terms of certification, the reference level is not certified. The error bars indicate 95% confidence intervals.

Conclusions

The IPCC, the EAT-Lancet Commission, and the WRI are prominent global entities advocating for a comprehensive dietary transition to address climate change and reduce the resource intensity of the global food system. In this study, we examined the willingness of consumers in three East Asian countries—China, Japan, and Vietnam—to adopt a dietary shift by choosing more sustainable food baskets. These countries collectively represent a significant portion, approximately 20%, of the world’s population.

Based on a large-scale transnational field survey, embedded food-basket choice experiments, and information nudges, our study provides insights into Asian consumer dietary preferences, including for different meat proteins. The results indicate that many Asian consumers still prefer traditional diets featuring rice and pork over alternative food baskets. Interestingly, our survey did not yield a sufficient number of declared zero-meat consumers, hindering a statistically valid analysis of food basket preferences of vegetarian and vegan consumers. This suggests that, at present, these dietary behaviors do not represent a significant trend among the surveyed Asian consumer populations.

However, there are reasons to believe that this will change in the future, and more consumers will opt for vegan/vegetarian food options. Future research should examine these populations more comprehensively to complement our findings.

Contrary to expectations, our results reveal that food culture and dietary habits, rather than income levels, play a significant role in shaping meat protein choices. Although animal-based protein consumption has increased in Asia, the consumption of

pointed to the importance of human health concerns as a motivator to support more sustainable agricultural practices.⁴⁵ Our analysis elevates this evidence to scale by showing that information nudges and related education campaigns may not have the potential to induce dietary transition on a cross-national scale for Asia, with the exception of very specific segments of the population. This is in line with similar studies on Western populations.^{28,64}

beef has not reached the levels observed in Western markets. Therefore, policy actions can be taken to shift this trend by appealing to food culture and traditions, rather than solely relying on the status associated with consuming beef.⁶⁵ Through sub-sample analyses focused on country, income, generational variables, and rural-urban variables, we identified several factors that influence dietary behaviors beyond meat choices. These findings provide insights into policy levers for targeted interventions to incentivize the adoption of sustainable diets. Income and generational variables emerged as the strongest influences on food basket choices, with higher-income households and younger consumers displaying greater concern for the sustainability of food production and a willingness to align their choices with sustainable food baskets through certification signals.^{42,45} Surprisingly, environmental food certification has a significant impact on consumer choice, surpassing income levels, generations, and country analyses. In our study, we specifically linked certification to sustainable practices. Interestingly, we found that information nudges focused solely on sustainability did not yield significant effects.⁶⁶ This leads us to believe that the influence of certification goes beyond the desire for sustainable outcomes alone. We hypothesize that certain quality attributes or other non-environmental factors may also be associated with the certification, thereby enhancing the effectiveness of this policy. However, further research is necessary to fully comprehend these underlying motivations. Regardless of the specific effects, food certification remains an effective motivator in promoting sustainable food consumption.

Although our study does not directly measure purchasing power or social context variables, we find that preferences for beef tend to increase with higher incomes and the associated social status effects.⁶⁷ These preferences, in turn, shape dietary food culture and contribute to increased awareness of the environmental impact of food production, although we find Asian consumers to be largely unresponsive to substitutions within the fruit and vegetable food basket categories.⁴⁵ Our study underscores the need for innovative public policies throughout Asia to support the demand for environmentally sustainable agricultural practices.

Information nudges in a DCE experiment did not significantly alter food basket choice decisions based on environmental knowledge alone.⁶⁶ However, when the messaging focused on individual well-being and its connection to intensive agricultural practices, we observed significant responses in food basket choices, particularly among older and rural participants in our population sub-sample analyses. This suggests that incentivizing dietary changes for the benefit of climate change or the food production environment alone cannot rely on Asian consumer environmental pollution concerns. Instead, greater motivation for diet transition can be achieved by highlighting the negative personal health consequences of current consumption habits, particularly among older consumers.⁶⁸ The fact that this behavior was more pronounced among older and rural cohorts aligns with the growing health concerns associated with aging and rural Asian households' exposure to the externalities of intensive agriculture in their immediate environment. Across China, Japan, and Vietnam, our findings indicate that consumer responses to information are not primarily driven by public inter-

est motives. Therefore, when implementing information and education policies as suggested by the EAT-Lancet Commission, it is crucial to emphasize individual health benefits and household well-being, particularly among older consumers, rather than focusing solely on the more abstract climate and environmental benefits of sustainable diets in an Asian context.

This study provides evidence of the strong influence of food culture and dietary habits in shaping food basket choices among Asian consumers. Incentivizing more sustainable consumption pathways will require policymakers and market agents to emphasize the importance of culturally appropriate food choices that align with national diet preferences and consumer desires to improve personal health outcomes. As our analysis suggests, the provision of information alone may not be sufficient to motivate direct climate action among Asian consumers. Therefore, a comprehensive approach that considers individual health benefits, cultural factors, and desired personal outcomes is necessary to effectively promote sustainable diets in Asian countries.

EXPERIMENTAL PROCEDURES

Resource availability

Lead contact

Further information and requests for resources should be directed to and will be fulfilled by the lead contact, Francisco Cisternas (fcisternas@cuhk.edu.hk).

Materials availability

No new materials were generated in this study.

Data and code availability

The data analyzed in this study can be made available upon request, with a few limitations. Complete set of data cannot be shared because some projects are still ongoing and sharing this data could negatively impact projects and their participants. The codes used to produce all statistics and figures can be made available upon request.

To examine Asian consumer willingness to engage in dietary changes to alleviate negative climate and environmental impacts, large-scale field surveys and embedded DCEs were conducted in China, Japan, and Vietnam.^{31,32} As part of the choice-experimental study design, three information nudges were developed and implemented to test the effects of information and education regarding the environmental, climate (GHG), or personal health consequences of intensive food production on respondent choices of alternative food baskets.^{13,36-38} Information nudges were carefully worded through several rounds of refinement to inform consumers about the effects of dietary transitions in the respective mitigation effort, and motivational factors toward these transitions (such as social norms, negative impact, and self-efficacy) were included.^{43,69-71}

Survey

The study was conducted following a receipt of ethics approval from the Survey and Behavior Research Ethics Committee (SBRE) at the Chinese University of Hong Kong. The survey was developed and implemented in Sawtooth software (Lighthouse Studio 9.8.1) to enable face-to-face interviews and the online delivery of the survey instrument (China and Vietnam 100% face-to-face, Japan 100% online delivery). Two pilot studies were conducted to field test the survey instrument (China, $n = 100$, May 2019; Vietnam, $n = 47$, March 2019).

After participants were screened for age (>18 years), individuals were randomly assigned into one of three information treatments or a control group. The survey questionnaire elicited respondents' answers to questions ranging from their environmental awareness, health concerns, food consumption patterns, and trust in relevant food system stakeholders to household demographics. The survey flow is presented in [Figure S1](#).

To account for participant heterogeneity in economic, educational, and socio-cultural factors, survey pilot feedback was used to revise, shorten, and simplify the survey instrument and information nudges. The subsequent study

Table 1. Attributes and attribute levels

Attribute	Attribute levels
Meat	(1) beef; (2) chicken or fish; (3) lamb (buffalo for Vietnam); (4) pork
Vegetables	(1) root vegetables; (2) brassicas or onions; (3) tomatoes
Fruits	(1) bananas; (2) apple; (3) berries (strawberries, blueberries, etc.); (4) citrus fruits (e.g., oranges)
Staple food	(1) rice; (2) potatoes or bread
Environmental certification for food producer	(1) certified producer; (2) no certified producer
Price	(1) –10% price reduction due to production methods savings or subsidies; (2) –5% price reduction due to production methods savings or subsidies; (3) normal price; (4) +5%, tax to pay for environmental problems or higher production cost; (5) +10%, tax to pay for environmental problems or higher production cost

implementation was carried out by trained interviewers when necessary. Screening questions following each information nudge assured participant comprehension and high-quality response data.

Participant sampling and data collection

The survey was conducted between July 2019 and January 2020. The Chinese portion of the study was administered and carried out by the Think-Tank Research Center for Health and Development (<http://www.healthtt.org.cn>) using its triennial health survey to reach a geographically and socio-economically representative sample of Chinese consumers via a multi-center randomized control sample of the population in five Chinese metropolitan areas: Beijing, Nanchang, Xian, Taiyuan, and Shenyang. Stratified sampling was conducted to achieve accurate representation: (1) the sampling was geographical, accounting for urban and rural areas including large city centers and peripheral neighborhoods in the above-mentioned cities; (2) the sampling was demographical, by matching age, income, and gender distributions of the country; (3) communities were randomly selected; and (4) local officials (e.g., village chiefs, community officials, and local health authorities) were contacted to help recruit participants with the required demographics for the study. It is worth noticing that working with local officials was the only method for personal data collection that Chinese authorities approved for the study. A total of 2,496 Chinese respondents completed the survey. The analysis included 2,029 valid responses after excluding incomplete and low-quality data, resulting in a completion rate of 81%.

The Vietnamese portion of the study was implemented by twenty trained volunteer interviewers via face-to-face interviews using a mix of paper-based surveys and tablets, depending on local conditions (e.g., internet availability). Survey respondents were located in urban and rural areas across major population centers of Ho Chi Minh City, Da Nang, Nam Dinh, and Hanoi. While Ho Chi Minh (8.6 million) and Hanoi (7.5 million) present highly developed urban centers, Da Nang (1 million) and Nam Dinh (400,000) represent less developed areas in Vietnam. A stratified geographical sampling of participants was applied to capture both rural and urban population centers. Within each designated geographical area, interviews were conducted across different neighborhoods to increase the diversity of respondents in terms of income, and stratified in terms of age following the country's age distribution. In total, 927 complete responses were collected, with a completion rate of 77%. Among Vietnamese participants, 122 valid responses resulted from the DCE experiment. The characteristics of participants with valid responses retained the intended demographic distributions matching the aggregate distribution of the country. To partially compensate for the low number of valid responses, each participant answered more DCE questions, thus increasing the volume of data. Access to the internet and the use of paper-based surveys limited the number of valid complete surveys as compared to the Chinese and Japanese samples.

Data for the Japanese survey sample was collected online (Lucid, <https://lucid.id>) across 47 prefectures including Tokyo, Hokkaido, Osaka, and Okinawa. Age and gender quotas were used to assure representation in terms of age, gender, and rural/urban population shares. A total of 2,133 complete re-

sponses were obtained with a completion rate of 67% after excluding surveys with unusually fast completion times. Demographic details are shown in Table S1. Geographic sampling was used to infer the income level of the Japanese and Vietnamese samples.⁷² Sample statistics are comparable to the corresponding country's populations, with some deviations for Vietnam's population (Table S1) due to the limited access to the internet in some areas. Although claims are based on significant results, they may not fully represent the whole country's population.

Information treatment (or nudges)

Before entering into the discrete choice experimental portion of the study, respondents were randomly assigned to groups and provided with information abstracts (nudges) designed to influence their food basket choice behavior toward more sustainable choices, following established procedures.^{73–75} Other than the control group, each treated group read short and neutral abstracts on (1) the effects of a higher demand for resource-intensive animal-based products on agricultural GHG emissions, (2) the effects of resource-intensive agricultural production on natural environmental conditions, and (3) the human health consequences of agro-environmental pollution. All treatments alerted participants to the fact that their personal dietary and food basket choices could support more sustainable farming practices and help mitigate the negative environmental and climate externalities of current agricultural production practices. Treatment I focused on the role of diet preferences on the environment, while treatment II focused on the impact of food production. A similar approach has been implemented in other studies.^{28,64} These studies specifically aimed to test the effect of information nudges on meat consumption. However, the scope and goal of our study are oriented toward generating recommendations for policymakers. Information statements were based on current projections for China but were framed in terms of their broader implications to appeal to respondents in all three countries.^{43,69–71} Information nudge-specific questions were included in the survey to verify comprehension, and the trained interviewers assisted participants in clarifying content and context when necessary. Level of comprehension was also used as a filter to increase quality, eliminating participants with low comprehension of the study context. During the survey, participants were allowed to go back and re-read the information nudges provided to them. The information nudges used in the study are provided in section “participant sampling and data collection” in the supplemental information. Participants in the control group did not receive any information and skipped the related filter questions. The effectiveness of the information nudges was formally investigated by analyzing differences in choice behaviors and WTP levels between the information nudge groups and the control group.

DCE design

The study used an established DCE framework to analyze consumer preferences for sustainable food basket choices and trade-offs between diet preferences and their environmental (climate) impacts as a means to quantify Asian consumer willingness to actively engage toward sustainable diets.^{36,76}

The six food basket attributes comprised a meat protein (status quo pork), a vegetable (status quo tomatoes), fruit (status quo citrus fruit), and starch component (status quo potato/bread), food basket price, and a binary indicator for the certified sustainability of the included food items,^{41,42} as shown in Table 1. Individual food items were selected to best reflect the heterogeneity in diets across the studied countries and to maximize the food's relative environmental impact using evidence from the literature, specifically its GHG footprint and resource intensity.^{2,43} For example, 100 g of chicken/fish protein is associated with average GHG emissions of ~6 kg CO₂equiv, whereas GHG emissions associated with lamb are almost three times that amount and beef emissions are eight times that amount. Presenting non-labeled food items in a simplified food basket approach was chosen for its ease of understanding and to minimize the cognitive burden on respondents to assure data quality and reliability.^{26,37} The food basket DCE approach and the selected food item design were thoroughly tested during the study's pilot phase carried out in both China and Vietnam. During the pilot, each participant was presented with three diet choice options that considered food culture and habits: a regular diet including one meat protein (beef, chicken/fish, or pork) and a vegetarian or no-pork diet (no animal protein, beef, or chicken/fish). Because of the pilot study, status quo attributes representing a mainstream reference diet for the DCE were set to pork, tomatoes, citrus fruits, potatoes, or bread, and no certification of environmental quality of food items (or baskets).

Prices of food baskets were introduced in the form of percentage deviations from the typical costs of comparable food baskets in the respondents' countries and regions. This approach was taken to provide participants with realistic (self-determined) levels of food costs in an otherwise highly heterogeneous food price environment that varies significantly by country/region, retail market type, and related product quality levels (e.g., rural Vietnamese wet market versus Tokyo formal supermarket). The magnitude of price variations across food basket alternatives was set to a range between 5% and 10%, which corresponds to levels of taxation or subsidization in other non-food sectors considered by governments in our study countries, to incentivize desirable choice behaviors. DCE attributes and levels are summarized in Table 1.

The survey's experimental framework was implemented with the Sawtooth software package, using an orthogonal main-effect choice experimental design. The total universe of 960 food basket choice sets was determined by all four randomized food item attributes, the binary certification attribute, and the five price levels. After eliminating unrealistic (extreme) basket options, an experimental sample of 480 food baskets was presented to respondents in sets of two basket choices using random selection without replacement. Each respondent evaluated seven food basket choice sets, as shown in Figure S2. The design did not provide an opt-out or no-purchase option.³¹

Data obtained from the DCE, together with related survey response data across information treatment groups, was used in the estimation of multinomial logit (MNL) models to investigate how the presence of food basket attributes and information provision affected respondent preferences and WTP for sustainable food basket options.^{26,39–41} The results presented in this paper focus on part-worth utilities and WTP estimates for key food basket items of interest based on aggregate data, and country-specific and socio-economic variable effects. Attribute part-worth utilities and WTP were calculated relative to the reference diet food basket. Further details can be found in sections "DCE design," "multinomial model and WTP," and "1.6" in the supplemental information.

Multinomial model and WTP

To analyze consumer preferences, we implemented a MNL model by hierarchical Bayesian estimation provided by Sawtooth CBC/HB. Other model specifications such as conditional logit, mixed logit, and latent class logit models were also tested and they are robust to the main findings (see Tables S12–S14). Note that the parameters can be scaled with a constant due to the ordinal nature of the consumer utility, considering this, we observe that the WTP analyses and WTP are highly similar across all the different models. The heterogeneity analyses were performed by subgroup estimation and mixed logit models with interactions tested to validate robustness (see Tables S15–S17) where for example, the coefficients of meat types and age interactions are all negative, corresponding to the downward trend of all meat

types other than the baseline along with the age segments in Figure 2C. This method for representing consumer choice is widely used.^{31,32} Different food baskets are presented to participants, and they indicate their choice. This choice is inferred as revealing their preferences. In the model, we construct a latent random utility of each food basket as a linear combination of its food components, similar in implementation to that of a recent study,³⁶ where we include an idiosyncratic random term assumed to have type I extreme value distribution for tractability, as it yields a closed form for the choice probabilities. Thus, if we have food baskets i and j , with corresponding utilities μ_i and μ_j , if we observe consumers choosing basket i over j ($i \succ j$), then we infer that $\mu_i \geq \mu_j$. Because the utilities are constructed using the food items of the basket, we can now infer preferences from the basket components, identifying their contribution to the latent utilities. The linear formulation of the utility is a compensatory model, where we can compensate the utility decrease of one attribute with an increase in another. We used this property to compute WTP, analyzing the change in an attribute and looking at the corresponding compensation in price to maintain the same utility level. All details for these calculations are in section "DCE design" in the supplemental information; the part-worth utility estimation results are in Tables S2 and S3; the WTP results are in Tables S4 and S5.

SUPPLEMENTAL INFORMATION

Supplemental information can be found online at <https://doi.org/10.1016/j.crsus.2024.100020>.

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AUTHOR CONTRIBUTIONS

Conceptualization, M.C., L.A.T., H.-M.L., and F.C.; methodology, F.C. and C.S.; data collection, M.C., L.A.T., C.A.C., and F.C.; Vietnamese data collection, N.P.; Chinese data collection, B.H. and Z.L.; survey software implementation, C.A.C.; data analysis, C.S. and F.C.; draft the manuscript, C.A.C., S.A., C.S., and F.C.; funding acquisition, H.-M.L., L.A.T., and M.C.

DECLARATION OF INTERESTS

The authors declare no competing interests.

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