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REPORT

Opportunities to achieve healthy, sustainable food choices in China through behavior change

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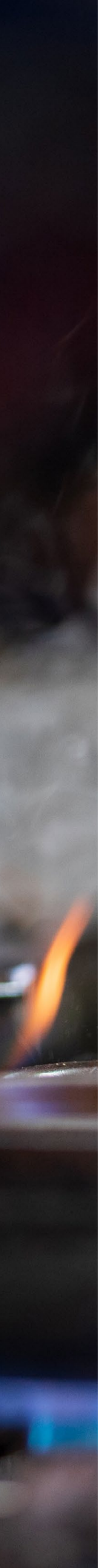

Foreword

China has seen remarkable evolution in its dietary trends over the past several decades. Undernutrition has been broadly eradicated, and more and more people have embraced innovation in new food products and retail environments. Although there is much to celebrate, this evolution has come with its challenges. Food imports have grown to meet demand, obesity is on the rise, and—as in many countries around the world—there is growing concern over the food system's impact on nature and the climate.

Safeguarding future food resilience has become a leading priority for the Chinese government, as exemplified by President Xi's "Big Food" concept, which calls for an effective supply of major food groups and protein diversification, improving the efficiency of domestic agricultural production, and reducing food waste to meet changing population demands. China's Dietary Guidelines, which were updated in 2022, are another critical opportunity to promote a resilient food system through healthy and sustainable diets.

This WRI report could, therefore, not be timelier. In first-of-its-kind research, WRI has undertaken an in-depth review of dietary trends in China and identified behavior change strategies to accelerate widespread adoption of the Chinese Dietary Guidelines.

Our behavior change framework outlines what we believe are the most promising interventions to shift diets across six key areas of People, Product, Policy, Presentation, Promotion, and Placement. As well as critical gaps in knowledge, the report identifies actionable opportunities to drive behavior change, such as leveraging e-commerce platforms and exploring the role that novel proteins can play.

Our findings have been developed through an in-depth review of the academic literature and extensive engagement with local and international experts. We hope this report will create a powerful evidence-based foundation for researchers, businesses, and policymakers to design and test which interventions will be most effective in real-life settings—and ultimately, to drive healthy and sustainable diets on the scale that's needed.

The next critical phase must involve stakeholders across government, academia, civil society, philanthropy, and industry working together to further develop the evidence base for how behavioral science can catalyze widespread adoption of sustainable diets. We look forward to working with leaders from across these sectors to achieve this.

DR. FANG LI
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Executive summary

China's economic development has driven significant changes to diets in the country. In this report, WRI examines how ways of eating are changing in China and outlines a behavior science framework to promote healthier and more sustainable diets.

HIGHLIGHTS

- Widespread adoption of the 2022 Chinese Dietary Guidelines (CDGs) could yield a "triple win" for China, improving food security and health, and reducing the nation's diet-related environmental footprint.
- Divergence in food intake estimates from different data sources underscores the need for further research using validated, internationally comparable assessment tools in China.
- According to estimates from the National Health Commission of China (NHC), the Chinese population currently overconsumes livestock and poultry meat and cereals compared to the 2022 CDGs, and underconsumes aquatic products, eggs, dairy, fresh fruit, and legumes and nuts.
- Much behavioral science research has already been published on ways to promote changes in food choice internationally, although relatively little has been conducted in China to date.
- We outline a "6P" food behavior change framework relevant to China, summarizing a range of evidence-informed interventions to promote adherence to the CDGs, clustered under the six categories of People, Product, Policy, Presentation, Promotion, and Placement.
- Further food-related behavior change research is urgently needed in China to determine which 6P approaches are most feasible to implement and will lead to the greatest number of people adhering to the CDGs, thereby benefiting individual and planetary health.

China has improved its people's diets and significantly reduced malnutrition. However, with economic development and rising living standards, traditional food choices in China are increasingly being superseded by a more Westernized pattern of eating. This includes more fat, protein, sodium, and sugar, leading to health problems, such as the excessive weight and obesity particularly prevalent among urban consumers but also rising rapidly in rural areas.

Meanwhile, safeguarding food security is a leading concern for the Chinese government. The "Big Food" concept it presented in March 2022 focused on ensuring an effective supply of major food groups, improving the efficiency of domestic agriculture, and reducing food waste. It highlighted as a priority the diversification of food sources (AGFEP 2022). If the Chinese population were to adhere to existing Chinese Dietary Guidelines (CDGs), benefits could be achieved for population health, food security, and the environment. One conservative estimate has suggested that, by 2030, widespread adoption of the CDGs would help to save somewhere between 146 million and 202 million metric tons of food-related greenhouse gas emissions (AGFEP 2021).

In the first half of this report, we explore current food intake patterns in China, outline future consumption trends, compare these to the 2022 CDGs and other dietary guidelines, and discuss the consequences of these eating patterns for both human and planetary health. In line with Chinese government priorities, we emphasize the need for more widespread adoption of the CDGs and highlight the "triple win" for food security, health, and sustainability that could result from more of the Chinese population following dietary guidelines.

We also identify variations in food choice patterns, noting that shifts in intake have not been uniform across China. We explore geographic differences in food choice between urban and rural areas, as well as regional patterns that result from localized food production practices and favored cuisine styles. We examine sociodemographic variations in food choices and find thriftier and more traditional food purchasing habits in older individuals than in the young, who place greater value on convenience and innovation, while men consume more meat, sodium, and oil, and less fruit than women. The food choices of higher-income households differ from those of poorer households in China: as incomes rise,

people tend to eat out more frequently and consume more expensive products, such as organic foods (Zhang et al. 2018; Cheung et al. 2021).

In the second half of this report, we summarize a range of behavior change approaches to improve the food environment and promote adherence to the CDGs. The framework outlined in this section contextualizes to China the recommendations of World Resources Institute's *Playbook for Guiding Diners toward Plant-Rich Dishes in Food Service* (Attwood et al. 2020). We first explore major drivers of food choice in China, highlighting how these differ from other countries where more behavioral research has been conducted. We recognize key differences in the food environment in China, including a far more fragmented retail market and a sizeable and growing online grocery market, which has transformed food access in rural areas and lower-tier cities (Woetzel 2019; Good Food Institute 2018). We explore differences in food advertising practices across the country and discuss rising interest in healthier diets, partly attributable to the COVID-19 pandemic and the public's resulting deepened awareness of the link between food and health (Qi and Ploeger 2021). We explore other individual factors that influence food choice, including personal concerns around food safety and awareness of the link between environmental sustainability and food choices (Carnovale et al. 2021). Finally, we describe some broader cultural influences on the diet and attempt to understand how aspects such as collectivist attitudes and a "banquet" culture of offering copious dishes influence eating norms (Campbell 2022).

Following this, we present a "6P" dietary behavior change framework, outlining six major target areas for behavioral intervention to encourage adherence to the CDGs: People, Product, Policy, Presentation, Promotion, and Placement (Attwood et al. 2020).

People refers to behavior change approaches that apply to individuals responsible for preparing and selling food. For the Chinese market, chefs, restaurant owners and managers, product developers, food bloggers, and influencers all have great potential to develop new and exciting recipes and formats of healthier, more sustainable meals, and to accelerate the population's adoption of these innovations. We also explore the potential for medical and health professionals to support adoption of the CDGs. Behavior change interventions could be developed that target the most influential members of family or social groups, so they may encourage all members to follow the CDGs.

Product refers to changes to the composition, preparation, availability, or presentation of food on offer. One relevant consideration for China is to further incorporate sustainability into the CDGs, especially considering ways to diversify the existing dairy recommendation, to enable nutritional needs to be met through a wider variety of foods. We highlight practical interventions to enhance healthy and sustainable ingredients in dishes and products. These include adding more plant-based protein to meals by leveraging sources already common in Chinese cuisine, including tofu, as well as research exploring the potential of alternative proteins, which include plant-based, as well as fermented and cell-based, versions of commonly enjoyed meat, fish, and dairy products (Wang 2022).

Policy includes behavior change approaches that require government support to implement. Recognizing the pre-eminent role that price plays in influencing food choices, we explore financial levers at the disposal of Chinese policymakers, including income transfers to rural populations (AGFEP 2022). We also discuss public food procurement and recommend that public universities, hospitals, and other social projects implement more sustainable and healthier food purchasing practices to influence the daily food choices of large numbers of people. Given that Chinese government policy priority-setting is evidence-based, we highlight the need for more regionally tailored behavior change research, including in-country tests of approaches proven to work in international settings, trialing novel interventions designed specifically for Chinese retailers and food service providers, and more interdisciplinary research and collaboration.

Presentation refers to interventions that modify the framing, layout, or design of food menus, labels, and signs. The first consideration is for research organizations to develop a national system to monitor and describe the environmental impact of a far wider variety of foods. In addition, further experimental research, in collaboration between academia, food retailers, and service providers, is needed to understand which label format best communicates this information to consumers. Conventions regarding how to describe healthier, more sustainable foods that have been proved to work in English-speaking settings may not be appropriate to the Chinese language and cultural context. We therefore suggest new narrative angles that may be better received by different sectors of the Chinese population (Jie 2017). These include

highlighting the local impact of changing food choices (such as reducing air pollution), discussing the "multiple wins" of CDG adherence (health, security, sustainability, taste, safety, etc.), emphasizing the health benefits of changing food choices, and describing how such changes can induce positive emotions. We recommend further research to understand which approach is most appropriate for different population segments.

Promotion includes typical food marketing and sales strategies, such as publicity and communications, advertising, or price promotions. We present a range of price-based interventions that food businesses could use to encourage uptake of the CDGs. Other recommendations focus on how food businesses can support communication of the CDGs and better publicize the link between food and sustainability to their customers. This includes developing differentiated communication strategies for different target groups, based on population profiling and segmentation, and improved utilization of social media, online communities, and forums to advertise healthier, sustainable options.

Placement involves modifying how food is displayed or accessed by consumers in restaurants and retail. We explore how expansion of online grocery and food delivery markets has opened new avenues to influence the food choices of Chinese consumers (Fernandez and Raine 2021). These include making interfaces for purchasing healthy produce more intuitive to use; including more attractive images of healthy, sustainable options; prefilling shopping baskets; and adding highly visible prompts to encourage food swaps. We outline placement techniques that physical retailers and restaurants could also employ. Examples include introducing "green food" offers in prominent positions and placing healthier, sustainable produce closer to eye level and within easy reach. Community markets can implement better zoning rules so that consumers know where healthy, sustainable produce is routinely situated.

To conclude the report, we summarize the most promising future opportunities to encourage adherence to the CDGs.

1. **Further incorporate sustainability considerations into the CDGs**, diversifying existing dairy guidelines and developing differentiated guidelines by region and for different demographic groups.
2. **Conduct more research on statistical methodology, dietary patterns, and behavior change strategies in China** to better understand consumption habits and target change interventions.
3. **Maximize the potential of behavioral science to promote dietary change**, learning from international research and conducting more behavior change trials in China, led by local researchers and partners.
4. **Leverage online food retail and e-commerce platforms to scale behavior change efforts**, recognizing the size and speed of growth of this sector in China, and the opportunity to better understand the user base.
5. **Conduct new research on alternative protein**, in line with the "Big Food" concept and the need to diversify food sources. It will be essential to fully evaluate the environmental, nutritional, and economic implications of alternative proteins, and what it may take to scale this sector in China.

Introduction

Chinese cuisine is iconic, comprising a multitude of dishes that are exported and enjoyed around the world. From Sichuan hot pot to Cantonese dim sum, the range of food choices in China is staggering, reflecting a long and rich cultural and culinary history, spread across the nation's 34 administrative regions.

In recent years, however, the Chinese have begun to shift their food choices, converging toward a more Western pattern of eating that includes more fat, protein, salt, and sugar (AGFEP 2021). Such changes have had mixed consequences for the nation's health, representing progress on some parameters, like reduced malnutrition, while simultaneously creating problems of overconsumption, including increased prevalence of obesity, hypertension, high cholesterol, and type 2 diabetes mellitus (T2DM) (Zhou et al. 2019). In response, the Chinese government has issued various policies, including the National Nutrition Program, 2017–30 (State Council of China 2017), and the Healthy China 2030 strategic action plan (State Council of China 2016), to tackle the coexistence of undernutrition and overnutrition, the frequent occurrence of nutrition-related diseases, and the need to promote healthy lifestyles.

However, human health is not the only area affected, as changes in food intake also have implications for food security and the environment, with consumption of animal-based foods a particular concern. Overall, according to data from the Chinese Health and Nutrition Survey (NHC 2022), intake of livestock, pork, and poultry is higher than recommended in the 2022 Chinese Dietary Guidelines (CDGs) (CNS 2021; Springmann et al. 2020).

The CDGs are guidelines for food selection and physical activity based on nutritional science and human nutritional need, combined with consideration of local food production, supply, and living conditions. The CDGs form the basis of national public nutrition policies in China and are seen as essential to achieving public health goals. The contents of the CDGs reflect the consolidated views and positions on diet and health held by academics and health management departments (CNS 2022).

In recent years, more and more studies have begun to discuss links between food and the environment, emphasizing the need for wider adoption of the CDGs to support both the health and sustainability goals of China (see Tables A3

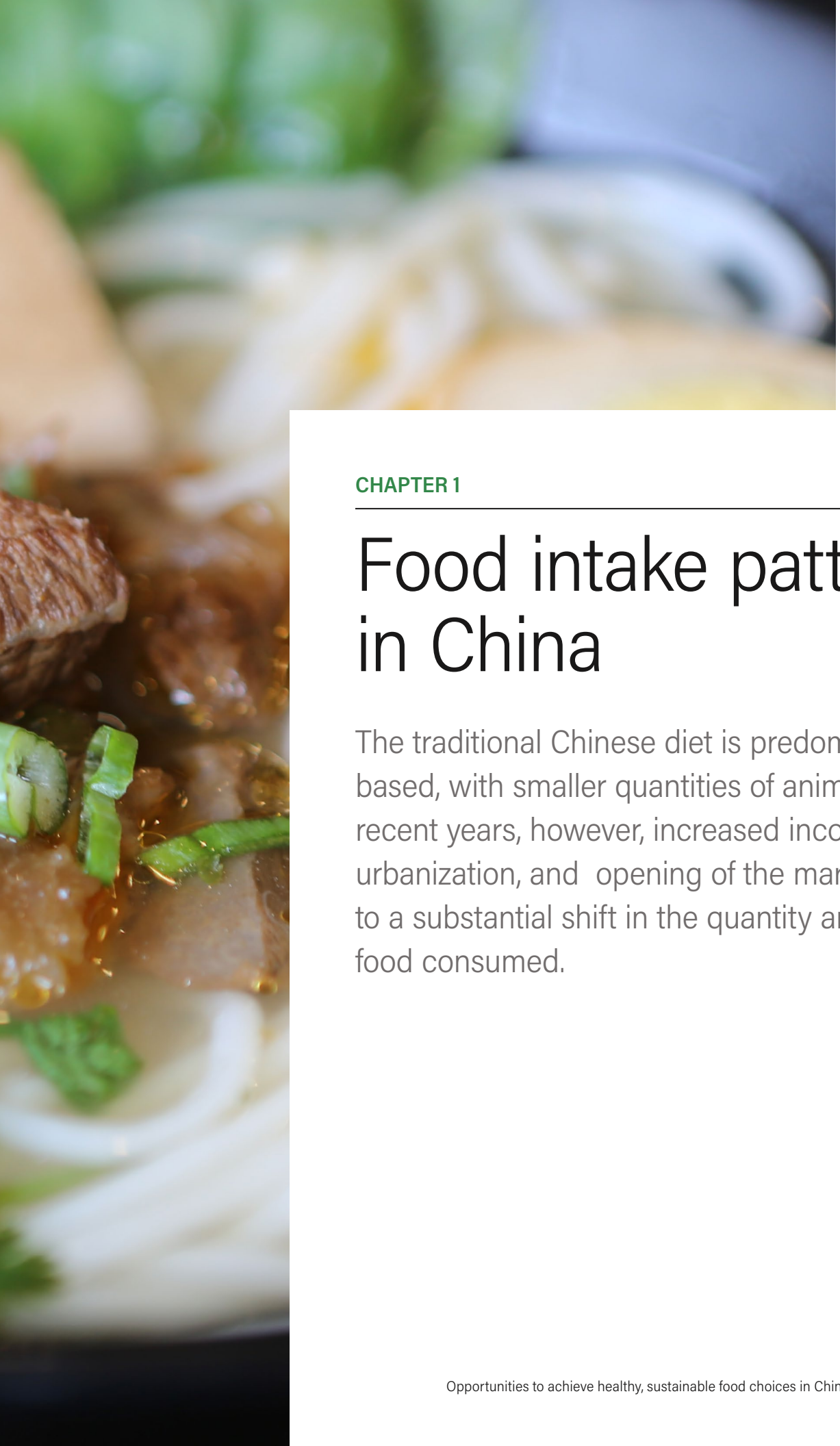
and A4 in Appendix A). If the CDGs were adhered to by most of the Chinese population, a "triple win" of benefits could be realized for population health, food security, and the environment.

The goal of this report is to draw on behavioral science research to identify evidenced-informed solutions to encourage the Chinese population to adopt healthy and sustainable eating patterns that align with the 2022 CDGs. In Section 1, we outline current food intake patterns in China, as well as future consumption trends, compare these to the CDGs, and explore potential consequences of these eating patterns for both human and planetary health. In Section 2, we identify key drivers of food choice in the country.

In Section 3, we detail a range of behavior change approaches to encourage adherence to the CDGs. Due to a lack of behavioral science research on eating habits in China (Simões 2016), we map an understanding of Chinese food culture using WRI's existing evidence-based behavior change framework (Attwood et al. 2020). We highlight the behavior change approaches that we deem most relevant to promote uptake of the CDGs, accounting for local food culture and region-specific barriers to change, as well as identify novel approaches unique to China.

Our report is based on original data analysis, interviews with 40 stakeholders, and a scoping literature review. The interviews have been anonymized and are cited in the text parenthetically ("interview source"). See Appendix A for details on our methodology.

This report is one of few attempts to date to provide a comprehensive list of evidence-based, behavior change approaches to promote healthy, sustainable food choices that is specifically tailored to China. In producing it, we hope to foster further sharing of ideas and experience between China and other nations, offering a resource that can help China meet its goal of improving its people's nutrition by promoting adherence to the CDGs.



CHAPTER 1

Food intake patterns in China

The traditional Chinese diet is predominantly plant-based, with smaller quantities of animal protein. In recent years, however, increased incomes, rapid urbanization, and opening of the market have led to a substantial shift in the quantity and type of food consumed.

CURRENT STATUS OF FOOD INTAKE IN CHINA

Which foods are currently consumed in China?

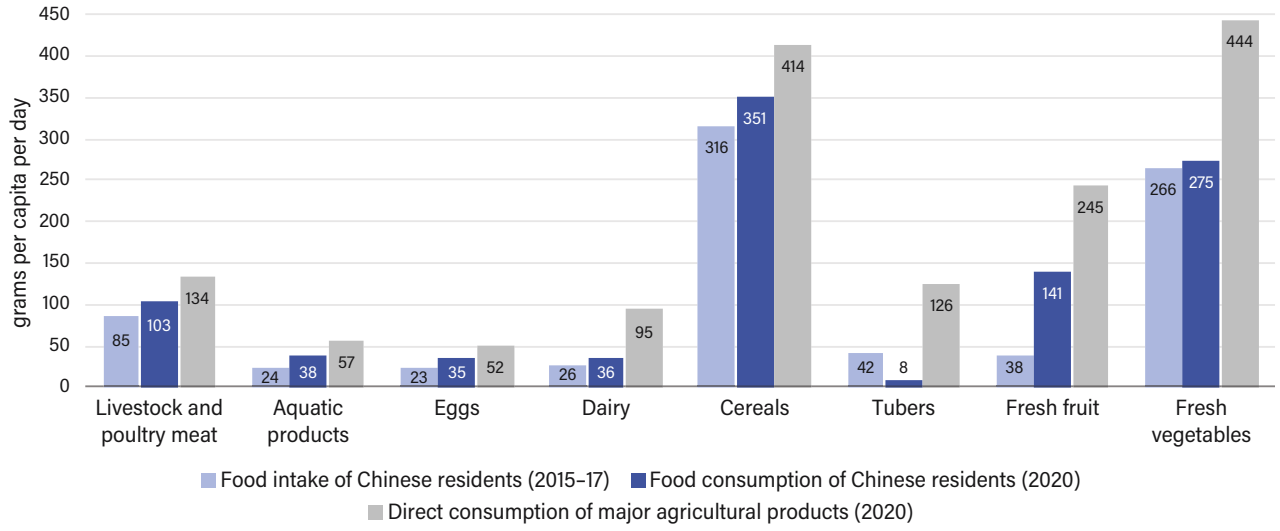
Major food groups

The traditional Chinese diet is mainly comprised of plant-based foods, with smaller quantities of animal protein (CNS 2022) (see Box 1 for information on available dietary data sets in China). In recent years, however, increased incomes, rapid urbanization, and the opening of the market have led to a substantial shift in the quantity and type of food consumed. Western-style products are increasingly incorporated into the Chinese diet, as are modifications of traditional Chinese meals. These include larger portions generally and of certain foods in particular, higher-quality ingredients, and more frequent eating opportunities (Huang et al. 2021a). Together, these changes have led to a rising intake of fat, protein, salt, and added sugar across the population (AGFEP 2021; Zeng et al. 2016).

BOX 1 | Comparison of major data sources

There are significant differences in food intake estimates between available dietary data sources in China, including those from the Ministry of Agriculture and Rural Affairs (MARA), the National Bureau of Statistics (NBS), and the National Health Commission (NHC). These are accounted for by different approaches to data collection. Figure B1.1 and Table B1.1 compare the food intake estimates of major food groups according to different data sources.

FIGURE B1.1 | Data comparison of major food group under different data sources



Sources: "Food intake of Chinese residents (2015–17)" is from the latest China Health and Nutrition Survey (CHNS) (NHC 2022) and only includes at-home food intake. "Food consumption of Chinese residents (2020)" is from the *China Statistical Yearbook 2021* (NBS 2022) and only includes at-home food intake. "Edible consumption of major agricultural products (2020)" is from the *China Agriculture Outlook Report, 2022–31* (MARA 2021) and excludes other consumption, such as feed and processing.

BOX 1 | Comparison of major data sources (Cont.)

TABLE B1.1 | Data source comparison

DATA	SOURCE	RELEASE AUTHORITY AND YEAR	MAJOR METHODOLOGY	DATA SELECTION
Food intake of Chinese residents (2015–17)	China Health and Nutrition Survey	National Health Commission (2022)	Probability-proportional-to-size sampling procedure with questionnaire survey, dietary survey, medical examination, and laboratory collection	Consumption side, focusing on nutrients entering the body, without out-of-home food intake
Food consumption of Chinese residents (2020)	*China Statistical Yearbook 2021*	National Bureau of Statistics (2022)	National Survey on Household Income and Expenditure and Living Conditions	Consumption side, based on the household bookkeeping of daily food consumption, without out-of-home food intake
Direct consumption of major agricultural products (2020)	*China Agriculture Outlook Report, 2022–31*	Ministry of Agriculture and Rural Affairs (2021)	China Agricultural Monitoring and Early-Warning System	Supply side, balancing production and imports, without other consumption, such as feed and processing

Sources: NHC (2022); NBS (2022); MARA (2021).

This divergence in estimates across different measurement approaches underscores the need for the use of validated and internationally comparable methods that will produce an accurate common estimate of the intake of all food types. Given that this report largely focuses on the 2022 CDGs, which are informed by data from the China Health and Nutrition Survey (CHNS), we have chosen primarily to explore CHNS data in our updated analysis of intake patterns.

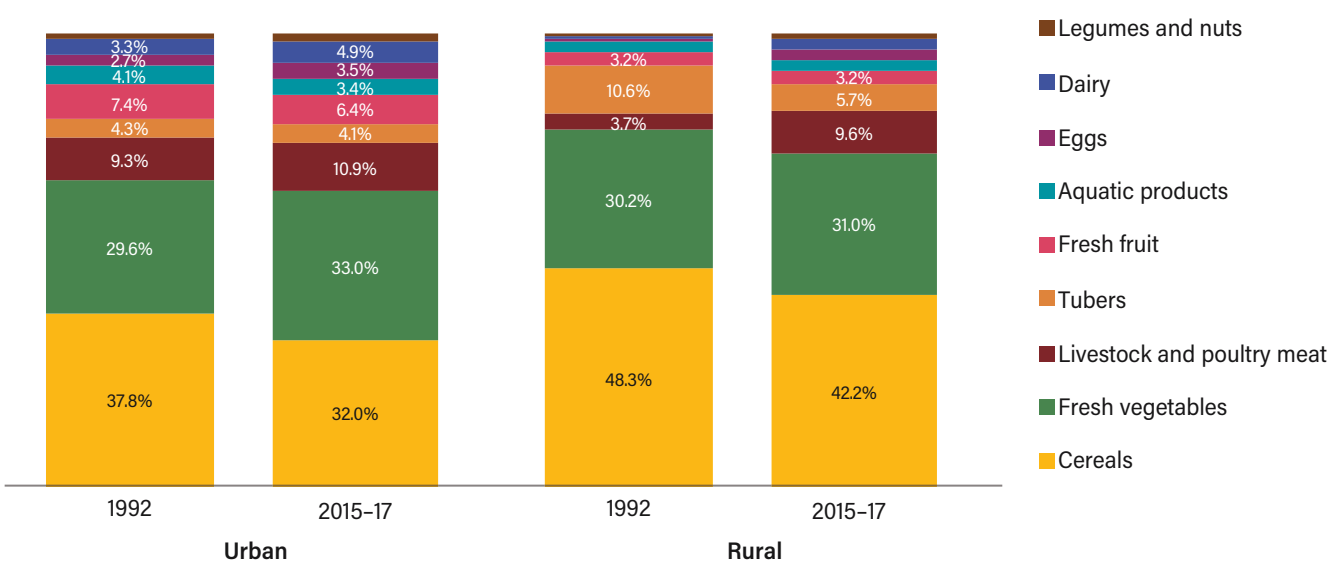
For full details of data sources and the analysis approach, please refer to Appendix A.

Figure 1 demonstrates fluctuations in intake of major food categories over a 30-year period in China, for urban and rural areas separately. There are substantial differences in food intake in cities and the countryside due to the relatively recent development of the rural economy, income differences, and targeted food-related policies.

Overall, the proportion of cereals in the diet (excluding out-of-home dining) has declined from 1992 to 2017, with intake dropping from 38 percent to 32 percent of the total urban major food group intake, and from 48 percent to 42 percent of the total rural major food group intake (NHC 2004, 2022). In general, cereal crops have tended to be replaced by other types of food as the Chinese diet has diversified and the population consumes more protein from animal-based sources (Tian et al. 2016). At the same time, a higher proportion of cereals still eaten are refined varieties, such as white rice or white wheat, while consumption of traditional, coarser varieties, like millet and sorghum, has declined (Chang et al. 2018b). This shift has implications for health, given that the latter are important sources of fiber and other essential vitamins and minerals. The reduction in consumption of coarse cereals has been more pronounced in rural areas, where these crops are traditionally grown. This is due both to changes in agricultural practices and to increased wealth in rural areas, which permits residents to choose refined cereals (Chang et al. 2018b).

Figure 1 also shows that the fresh vegetable intake proportion has slightly increased over the period, from 30 percent to 33 percent of the intake of major food groups in urban areas and from 30 percent to 31 percent of the intake of major food groups in rural regions between 1992 and 2017 (NHC 2004, 2022).

FIGURE 1 | Percentage of changes in intake of major food groups, 1992–2017, comparing rural to urban areas in China



Notes: Food intake of Chinese residents (1992) is from the first CHNS (NHC 2004). Food intake of Chinese residents (2015–17) is from the latest CHNS (NHC 2022).
Source: WRI China.

Conversely, consumption of legumes and nuts, on the one hand, and fresh fruit, on the other, has not changed drastically in urban or rural areas in the past 30 years. Both the increases in legumes and nuts and the decreases in fresh fruit are 1 percent or less.

Figure 1 also shows that between 1992 and 2017, rural residents increased the proportion of livestock and poultry meat in their diets versus other food types by 6 percent (from 4 percent to 10 percent of total grams of urban major food group intake), while urban residents increased by only 2 percent (from 9 percent to 11 percent of total rural major food group intake) (NHC 2004, 2022).

Meat intake in China is projected to rise further in the coming decades. Although available future projections vary, two estimates (also based on meat supply data) suggest a rise of between 16 percent (OECD 2021) and 19 percent (MARA 2021) between 2020 and 2030. There is, however, some expectation that the dietary structure will also transition in this period, leading to slower growth in the rate of meat adoption over time (CNS 2022).

Dairy intake also increased over this period, from 3 percent to 5 percent of the total urban food intake, and from less than 1 percent to 2 percent of the total rural food intake (NHC 2004, 2022). Similarly, as Figure 1 shows, egg consumption has also increased among rural residents, by 1.4 percent in the period (i.e., more than doubled, but from a low baseline of 0.9 percent to 2.3 percent), but it has stayed relatively consistent for urban populations (i.e., an increase of 0.8 percent from a baseline of 2.7 percent). For aquatic products, intake appears to have remained relatively stable, decreasing slightly in urban populations by 0.7 percent and increasing slightly in rural populations by 0.6 percent of total food intake.

Demographic and geographic differences in food intake in China

When interpreting food consumption data for a country as vast as China, it is important to account for within-country variation, as national average values can obscure important differences between demographic groups and geographic regions. Understanding this heterogeneity is essential when designing appropriate diet-change strategies, which should be targeted to specific groups in the population to ensure relevance and effectiveness. Below we outline some of these patterns, but this is not an exhaustive description.

Geographic differences

Remarkable regional variation is apparent in the types of food eaten across China. For example, residents of southern and eastern coastal areas consume far more aquatic products, due to their abundant fisheries (AGFEP 2021). In northern and western China, people eat more beef and mutton, due to both the concentrated livestock farming in these regions and the dietary preferences of local communities (Mao et al. 2016).

Traditionally, access to certain products in all regions has been constrained by infrastructure and supply chain limitations, such as incomplete cold chains to transport chilled products between distant areas. This is changing, however, as interregional supply chains evolve to meet demand.

Distinct regional cuisines have also developed over China's history. These are many and diverse, but they broadly center on four major styles: Sichuan, Jiangsu, Shandong, and Cantonese (Zhang and Ma 2020).

Socioeconomic differences

Socioeconomic status can be measured in various ways, including by wealth and education level. Households with higher income tend to consume more foods perceived to be of higher quality, including more organic produce (Zhang et al. 2018). However, higher income is also associated with certain habits less beneficial to health, like more frequent eating out and greater intake of red and processed meat (interview source). These two behaviors are themselves linked, given that a large proportion of meat consumed in China is eaten away from home, especially dishes containing beef and mutton, which are more complicated to prepare (Mao et al. 2016). In rural China, eating more meat is still commonly linked with ideals of a happy and successful life, and is seen as a reflection of better social status (Happer and Wellesley 2019).

Higher education levels are associated with greater purchasing of organic foods and higher likelihood of shopping in supermarkets as opposed to other retail formats in China (Thøgersen and Zhou 2012). Educated consumers, especially educated women, have been found to pay more attention to diet-related health considerations and engage in more self-care (Chen et al. 2014).

Generational differences

Differences in food preferences are also evident across generations. Convenience is understood to be a leading driver of food choice in younger age groups, with data from one of China's largest online food delivery platforms, Meituan, indicating that Generation Z ("Gen Z," born after 1997) consumers had a 51 percent higher online food delivery frequency than the user average in 2021 (Meituan Research Institute 2022).

The younger generation is also understood to be more receptive to food-related trends, including rising interest in healthy eating (Nelson 2011). Higher usage of social media in this cohort means that advertising via this medium has an important influence on Gen Z's food choices. Food providers who create appealing brand stories and social media content are favored by younger Chinese, as are providers with positive social media coverage and reviews from Gen Z consumers' online social networks (Zuo et al. 2022).

Conversely, the older generation demonstrates more conservative shopping and eating habits. Overall, older individuals are more likely to buy produce from traditional sources, like local markets, and tend to consume thriftier, vegetable-based meals (Liu et al. 2019). The habits of older consumers are beginning to shift, however, with middle-aged and older consumers constituting a growing cohort with increasing spending power and a strong interest in health-related consumption. For example, from 2016 to 2020, the size of China's older-age or "silver" market increased, at an annual growth rate of 26 percent, with health-related purchases representing the highest proportion of this growth (iiMedia 2021).

Gender differences

Gender differences in diet are also apparent. For example, Chinese men have been found to eat more meat, especially pork, while research shows that Chinese women have comparatively greater health awareness and tend to consume more fruit, less cooking oil, and less salt (Zhang et al. 2018; Liu et al. 2019).

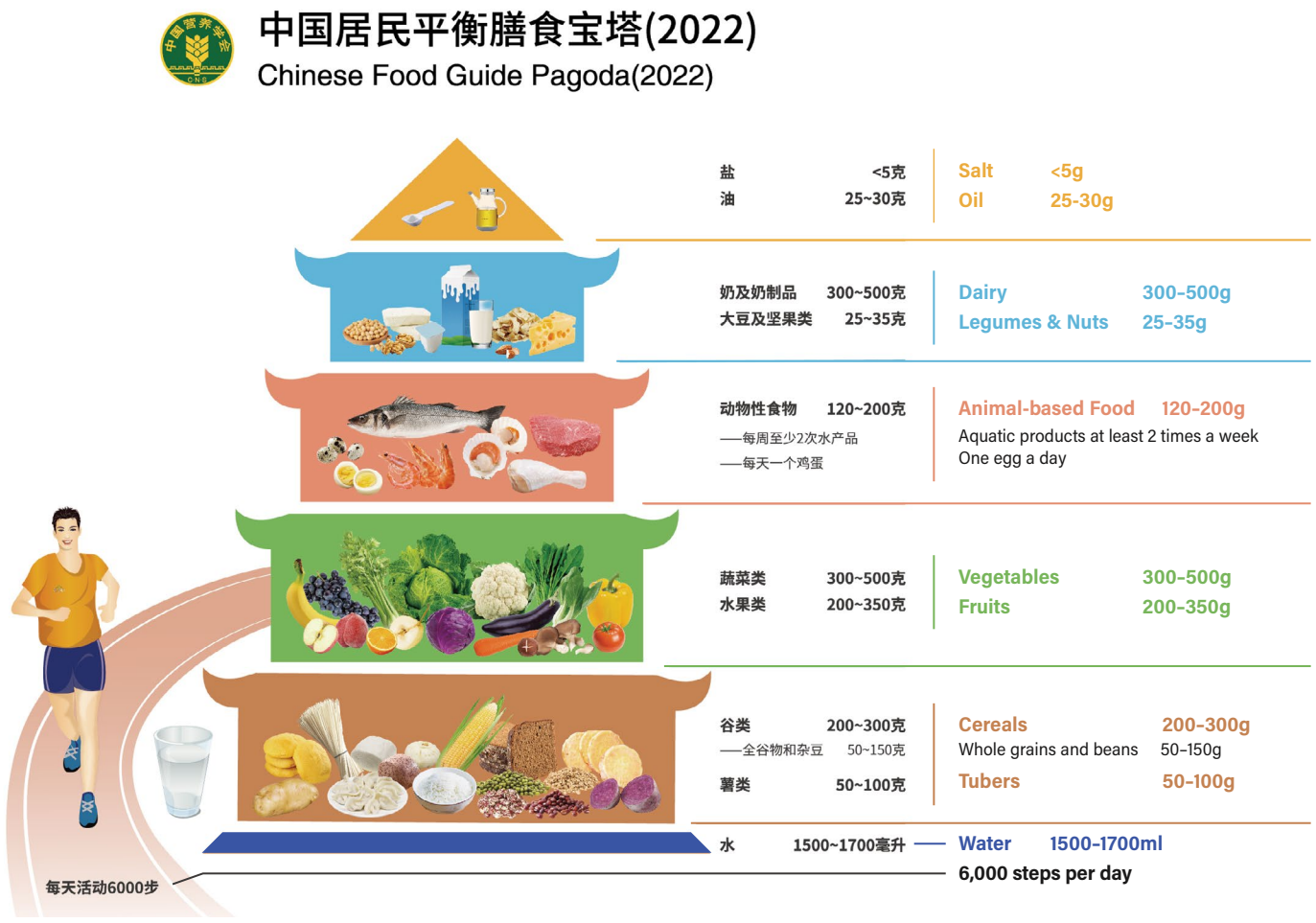
Family composition also affects food choices, with more money spent on organic food and higher expenditure on beef in families with children (Zhang et al. 2018). This is likely because both of these foods are thought to promote health, a key concern for Chinese parents (Zhang et al. 2018; Xie et al. 2020).

CHINA'S NATIONAL DIETARY GUIDELINES

Comparing dietary guidelines and current food intake in China

As with many countries worldwide, the major thrust of the CDGs (summarized in Figure 2), is to promote better health among the Chinese population. The latest version of the CDGs, published in 2022, also considers the impact of dietary choices on the broader environment, as indicated by the published CDG methodology explaining how these guidelines were developed (CNS 2022).

FIGURE 2 | Chinese Dietary Guidelines visualized as the Food Pagoda



Source: CNS (2022).

While the CDGs are a useful tool to inform citizens of how much of each food group they should eat per meal, or per day, these instructions can only benefit health if adhered to consistently over time. Figure 3 compares recent intake estimates of major food groups in China (from China Health and National Health Survey data), to both the 2022 CDGs and the EAT-Lancet recommendations, highlighting where consumption and guidelines both align and misalign.

The EAT-Lancet recommendations are a set of dietary guidelines that aim to promote consumption of foods beneficial to health, in line with UN Sustainable Development Goals (SDGs), while simultaneously reducing the diet's environmental footprint to within a "safe operating space" for humanity, in keeping with the environmental targets of the Paris Agreement (Willett et al. 2019).

EAT-Lancet recommendations represent universal guidelines and are not tailored to any specific geographical context or regional pattern of eating. One major criticism of this diet is thus that it does not account for baseline differences in dietary preferences, or for food affordability and availability in different regions of the world (Hirvonen et al. 2019). For example, meeting all recommendations specified in the EAT-Lancet diet would cost the equivalent of an estimated US$3.27 per day in East Asia, with fruit and vegetables accounting for the highest proportion of this cost (36 percent). In China, the value of the EAT-Lancet diet thus represents around 26–43 percent of daily mean household income per capita per day (Hirvonen et al. 2019).

As Figure 3 shows, comparing average CHNS intake estimates (column height) with CDG recommendations, intake of livestock and poultry meat and intake of cereals exceed both the 2022 midpoint and maximum consumption guidelines. The remaining major food groups are underconsumed compared to both the 2022 CDG midpoint values and the CDG minimum consumption guidelines, including aquatic products, eggs, dairy, fresh fruit, and legumes and nuts.

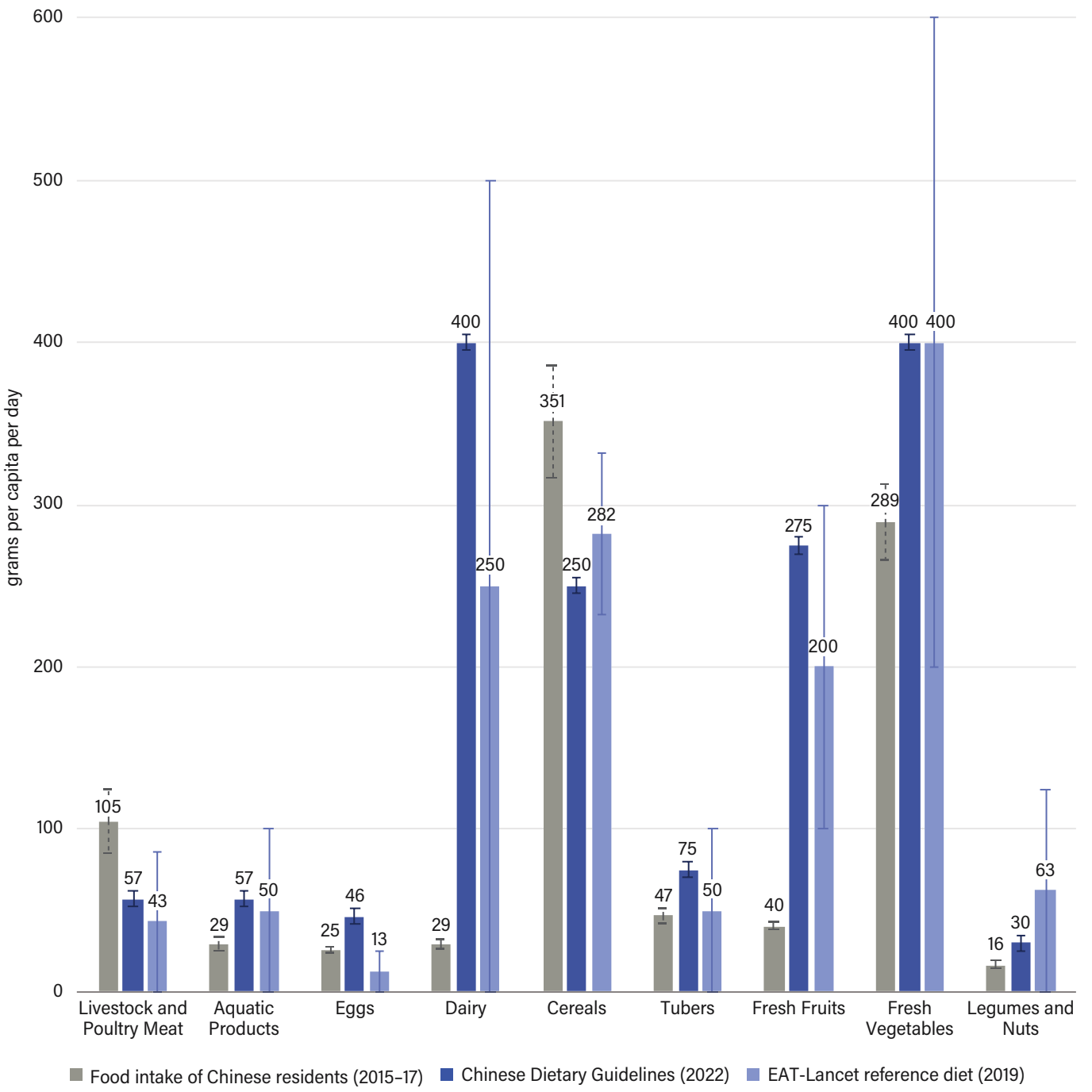
Similarly, comparing CHNS average intake with EAT-Lancet recommendations, we again see that intake of livestock and poultry meat and intake of cereals exceed both midpoint and maximum guidelines, while eggs are currently overconsumed according to midpoint guidelines but fall just within the EAT-Lancet boundary for maximum recommended intake. According to CHNS data, the average intake of fresh fruit, fresh vegetables, legumes and nuts, tubers, dairy, and aquatic products are all lower than the average recommended within the EAT-Lancet planetary health diet (although intake guidelines include possible ranges down to zero for aquatic products, dairy, tubers, and legumes and nuts).

Overall, many of the recommendations in the CDGs strongly align with those of the Planetary Health Diet. Were the Chinese population to adopt the 2022 CDGs, environmental gains would therefore be possible, in addition to health benefits. Observing the CDG recommendation for dairy could have particularly significant environmental impacts (see Box 2 for details).

In China, as in many other countries, getting the population to adopt national dietary guidelines is a challenge (Springmann et al. 2020). Research shows that China is one of 75 countries that have national dietary guidelines but whose population fails to meet all specified criteria (Springmann et al. 2020). China is in a comparatively better position than most countries, however, in relation to certain components of the diet—namely, meat consumption—meaning that there is a clear window of opportunity to implement behavior change interventions at scale in China, and thereby to improve adoption of recommended dietary intakes, avoid increased consumption of nonrecommended foods, and deliver the associated triple win for food security, health, and climate.

Were the Chinese population to adopt the 2022 CDGs, environmental gains would therefore be possible, in addition to health benefits.

FIGURE 3 | Comparison of 2015–17 food intake in China with the CDGs and EAT-Lancet reference diets



Notes: "Food intake of Chinese residents (2015–17)" represents current dietary intake, which is the latest available data from the China Health and Nutrition Survey (NHC 2022). CDG recommended intake is from the Chinese Dietary Guidelines (CNS 2022). EAT-Lancet reference diet is from EAT-Lancet (Willett et al. 2019). For the CDG and EAT-Lancet data, column heights and error bars represent the average and the range of the recommended values, respectively. EAT-Lancet bars include zero in the range in line with the published recommendations. For the "Food intake of Chinese residents (2015–17)" data, the error bars represent the intake estimates as unadjusted (lower bar) and as adjusted for out-of-home consumption (upper bar). The column height represents the average estimate of intake (see Appendix B). For CDG recommendations, "cereals" include whole grains and small beans (such as lentils and peas as staple food, not including soybeans and nuts). For direct comparison with EAT-Lancet recommendations, the "cereals" bar has been computed by summing of EAT-Lancet guidelines on "whole grains" and "dry beans, lentils, and peas" (not including soy, peanuts, or tree nuts).

Source: WRI China.

BOX 2 | Dairy recommendations in the 2022 CDGs

Compared to residents of many Western countries, the Chinese currently consume very low levels of dairy. The 2022 CDGs recommend increasing per capita dairy intake by nearly 1,000 percent from the present level (26–32 grams per capita per day), to between 300 and 500 grams per day.

Underpinning the current CDG guideline is the fact that dairy products are an easy, relatively cheap, and high-quality source of nutrition. Dairy is rich in protein, calcium, riboflavin, vitamins A and D, zinc, magnesium, potassium, and other essential elements. This is especially important given that research has indicated that up to 90 percent of the Chinese population was at risk of consuming too little calcium in 2012 (He et al. 2016), despite the Chinese government's urging its people to drink more milk since the 1980s.

Although Chinese per capita consumption of dairy has increased in recent decades, it is still lower than in many other countries in the Asia Pacific. Some explanations for lower intake in China include the fact that dairy does not feature in the traditional dietary structure, high incidence of lactose intolerance in the Chinese population (with some estimates suggesting that up to 100 percent of the population does not produce sufficient lactase—see Table B2.1 for international comparisons), and possible food safety concerns following the 2008 national scandal involving melamine-tainted milk powder (Good Food Institute 2018; Ortega et al. 2012).

TABLE B2.1 | Prevalence of lactase nonpersistence and lactase malabsorption in different populations

AREA	PERCENTAGE	AREA	PERCENTAGE
Chinese (LNP)	100%	Egypt, general (LM)	73%
Vietnamese (LM)	100%	Germany, general (LM)	70%
Japanese (LM)	100%	Hungary, general (LM)	56%
Bantu, Uganda (LM)	100%	Mexico, general (LM)	53%
Peru, non-Caucasian (LM	94%	Northern Italy (LM)	52%
Iraqi Jews (LNP)	93%	Fulani (LNP)	50%
Australian Aborigine (LM)	84%	Greece, general (LM)	45%
Nigeria Yorba (LM)	83%	UK White (LNP)	22%
Ashkenazi Jews (LNP)	83%	Finland (LM)	17%
Moroccan Jews (LNP)	82%	US White, general (LM)	15%
US Native American (LM)	81%	Central Italy (LM)	15%
Brazil, general (LM)	80%	Irish (LNP)	14%
Chile, general (LM)	80%	Danes (LNP)	12%
African American (LM)	75%	Swedes (LNP)	10%

Notes: LNP = lactose nonpersistence; LM = lactase malabsorption.

Source: Bayless et al. (2017).

Implications of current consumption patterns in China

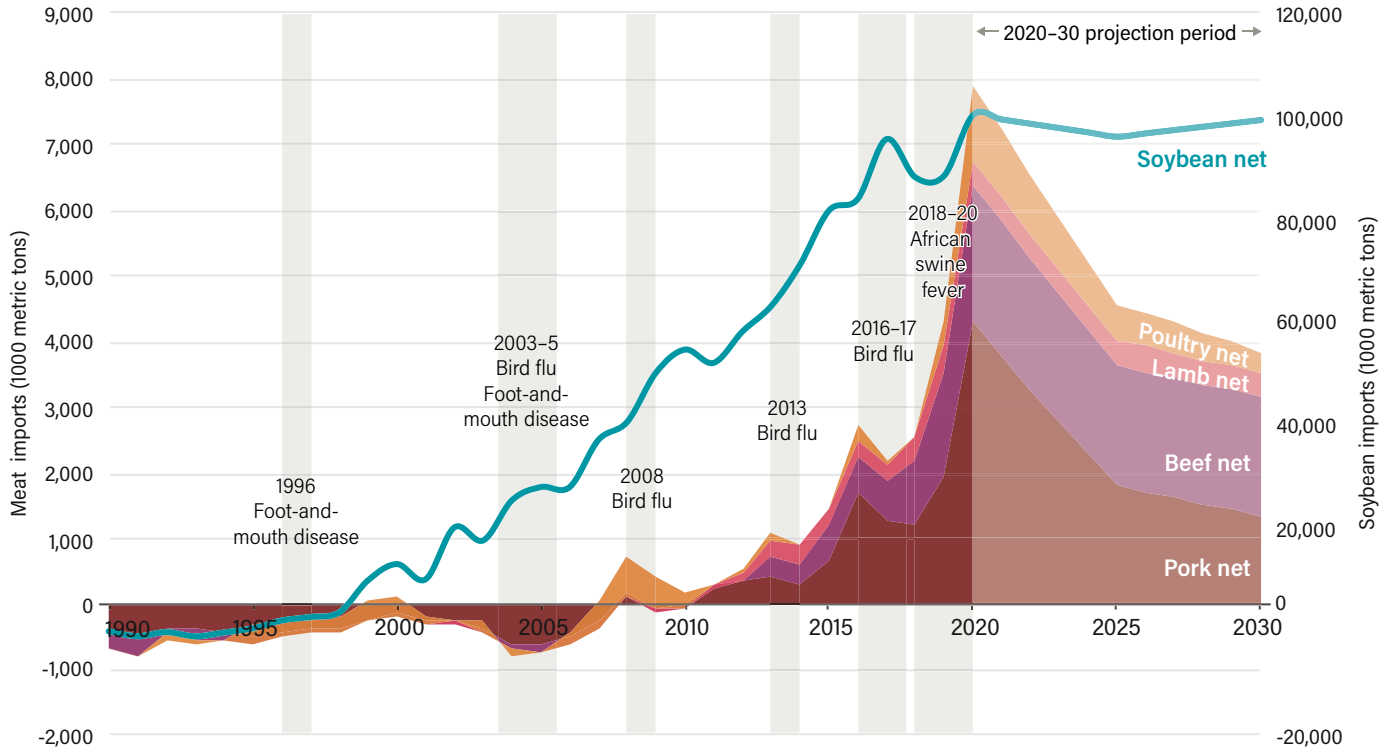
Food security

Encouraging adherence to the CDGs may also benefit food security in China. Between 2004 and 2020, China transitioned from an agricultural trade-surplus country to reporting a trade deficit that has grown from US$4.73 billion to $94.77 billion (AGFEP 2021).

China now imports large amounts of meat and soybeans for animal feed, as domestic production can no longer keep pace with rising demand for animal-based foods. This has resulted in China's being the world's largest importer of pork (Figure 4) and the fourth-largest buyer of agricultural land abroad (*Asia Post* 2022). China is also heavily reliant on soybean imports, primarily for animal feed, with major supplier countries including Brazil (53 percent), the United States (34 percent), and Argentina (7 percent) (Liu et al. 2021).

China's dependence on the international market for its food supply leaves the country at risk of exposure to external shocks, such as price hikes, import tariffs, and interrupted supply chains. As a result, safeguarding food security has become a priority for the government, and various new policies have been enacted to address this issue. This includes efforts to improve the efficiency of domestic agricultural production, particularly of soybeans, and to diversify food imports (*Asia Post* 2022). Diversifying protein to include more plant-based sources could help China buffer against factors that disrupt the steady supply of animal-based foods, including disease epidemics that significantly impact the country's livestock and poultry availability (see Figure 4 for trends). For further discussion of diversification into the emerging area of alternative protein, see Box 3.

FIGURE 4 | Time trends in total meat and soybean imports in China, 1990–2030



Sources: OECD and FAO (n.d.).

Health

Current and projected changes in food intake patterns have led to a "double burden" of disease in China, arising from underconsumption of some nutrients essential to health, leading to conditions like anemia and stunting in children, and overconsumption of others, leading to noncommunicable diseases such as hypertension, T2DM, and obesity (*China Food and Nutrition Development Outline* 2014; AGFEP 2021).

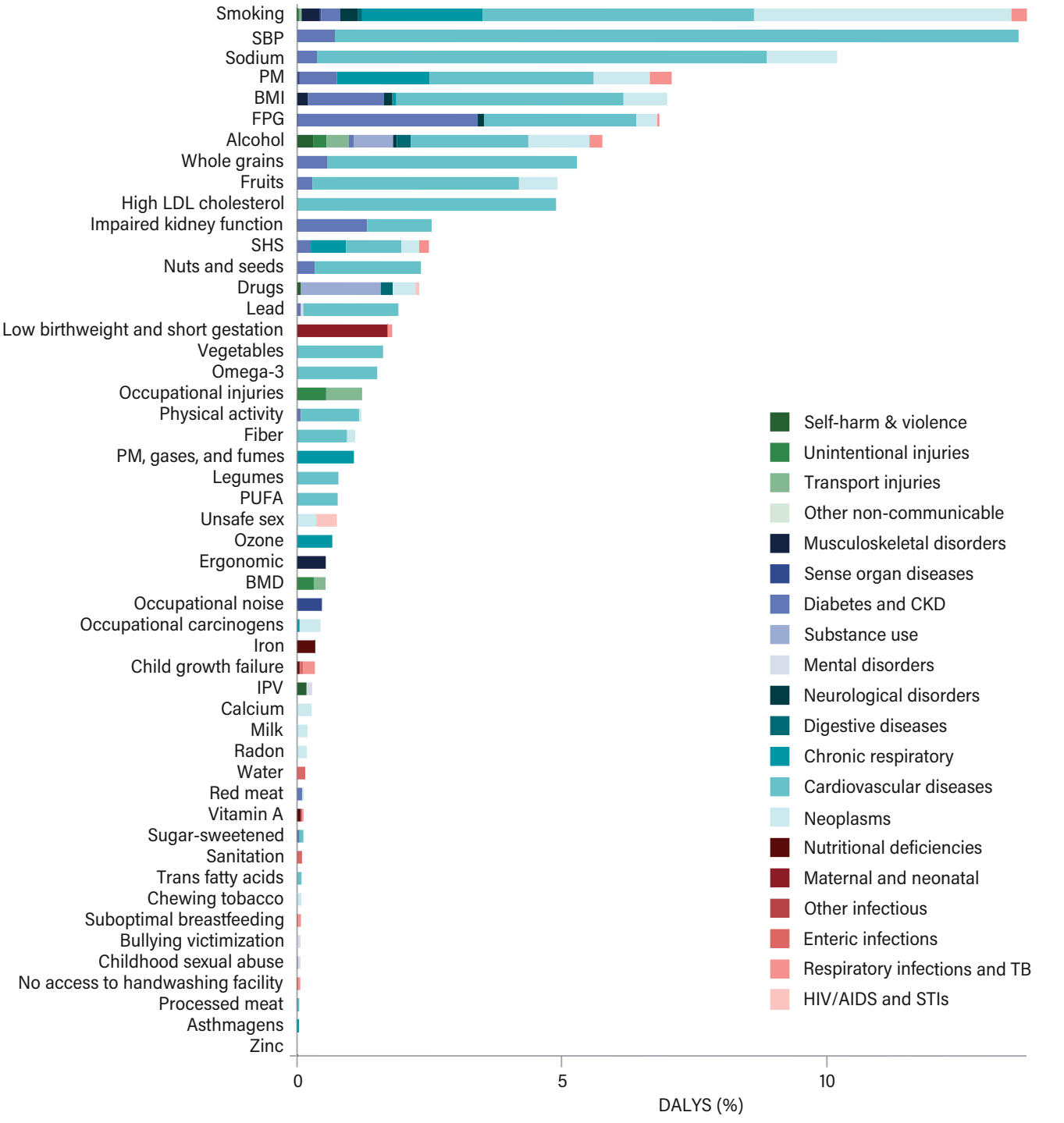
The proportion of overweight adults in China continues to rise, and now stands at half of the population (AGFEP 2021), with a 16 percent obesity rate in 2015 (Ma et al. 2021). This is predicted to increase to 25 percent obesity by 2030 if no successful diet-related interventions are introduced. This outcome would likely lead to spiraling health care costs beyond the 1.1 percent of gross domestic product (GDP), or $93 billion, spent treating obesity-related conditions in China in 2019 (Woetzel 2019).

Food choices not only impact body weight but also are linked to an array of other health outcomes, as shown in Figure 5, which depicts the burden of disease in the Chinese population attributed to different risk factors in 2017 ('disability adjusted life years, or DALYS'). Dietary factors dominate the list, including overconsumption of alcohol, sodium, sugar-sweetened beverages, and red and processed meat, as well as underconsumption of whole grains, fruit, nuts and seeds, vegetables, and milk (Zhou et al. 2019).

While increased meat consumption in China has added some important nutrients to the diet, especially protein, many popular meats in the country, such as cured and pickled varieties, are major dietary risk factors. This includes sodium, the third-leading risk factor for disease burden in China, and fat, which contributes to both high body mass index (fifth-leading risk factor) and high low-density lipoprotein (LDL) cholesterol (ninth-leading risk factor) (CNS 2022). Processed meats such as ham, bacon, and sausage are also significant sources of dietary nitrites. Nitrites, added to meat products as preservatives, produce N-nitroso compounds through chemical reactions when consumed. These can have a direct carcinogenic effect, significantly increasing the risk of gastric cancer (Song et al. 2015).

Beyond the direct negative health effects of meat consumption and other changes in food choices, recent research has also quantified some indirect health impacts. As Figure 5 shows, particulate matter (PM) in air pollution was the fourth-leading contributory factor to disease burden China in 2017 (Zhou et al. 2019). Analysis of earlier data suggests that around 5 percent of the 1.83 million premature deaths from air pollution registered in 2010 could be attributable to changes in diet and associated agricultural practices, such as fertilizer use and manure management.

FIGURE 5 | Number of disability-adjusted life years attributed to leading risk factors in China in 2017



Notes: Data for whole grains, fruit, nuts and seeds, vegetables, omega-3, physical activity, fiber, legumes, and PUFA all refer to disability-adjusted life years associated with insufficient quantities. AIDS = acquired immunodeficiency syndrome; BMD = low bone-mineral density; BMI = high body-mass index; CKD = chronic kidney disease; DALY = disability-adjusted life year; FPG = high fasting plasma glucose; HIV = human immunodeficiency virus; IPV = intimate partner violence; PM = particulate matter; PUFA = diet low in polyunsaturated fatty acids; SBP = high systolic blood pressure; SHS = secondhand smoke; STI = sexually transmitted infection; TB = tuberculosis.

Source: Zhou et al. (2019).

Environment

Food choices affect not only food security and health but also the environment, leading to both local and near-time impacts, such as farm-related air pollution, as well as more global and distant-term impacts, such as climate change (Happer and Wellesley 2019). Various studies have sought to model future environmental impacts of current food intake trends in China, with one study computing that between 2020 and 2030, around 146 to 202 million annual metric tons of greenhouse gas (GHG) emissions from agriculture would be saved per year if the Chinese population adhered to the 2016 CDGs during this period. This analysis compares the GHG emissions footprint of population adherence to the CDGs against a benchmark diet scenario that takes into account current consumption patterns and likely background trends occurring over the period (AGFEP 2021). We also note that this estimate is likely conservative, as it only considers reduction in agricultural production emissions due to dietary change and does not factor in the potential mitigation benefits of reducing agricultural land demand (and pressure on forests), which would positively impact both climate and biodiversity.

BOX 3 | Current and future considerations on alternative ("alt") protein in China

Context

As a category, alt proteins include plant-based formats (products made from plants designed to replicate the taste and appearance of meat, fermented formats (products made or supplemented with fermented yeast or bacteria), and cell-based format (products made from stem cells and cultivated in growth factors in the "lab") (Warner 2019), as well as hybrid formats that blend plant-based products with fermented or cell-based elements. Of these, both fermented and plant-based products already feature in the Chinese diet. Fermentation has been used for many years to preserve and flavor meat products like salted duck, sausages, and ham. Plant-based meats are also already widely available in China and commonly sold in more traditional vegetarian restaurants (Wang 2022).

Opportunity

Already a priority issue for the government, concerns around food security in China are predicted to increase in the coming years as climate change complicates the national food supply. For example, climate change may lead to more frequent droughts, flooding, and erosion of soil quality that are likely to curtail agricultural output (Campbell 2022). Alt proteins offer one possible solution to food security concerns, given that these products can be produced nationally under tightly controlled conditions and have the potential to support the population nutrition goal of diversifying protein intake. Here, major limiting factors to successfully scaling alt protein products include availability of the right technical infrastructure for mass manufacturing and ensuring access to intermediate ingredients and materials (interview source).

Demand for alt meats in China

So far, the plant-based alt meats that have already been introduced to the Chinese market have received relatively poor feedback from consumers. Criticisms have centered on health concerns, taste, and price, highlighting the need for development of products that better mimic meat and are sold at price parity (interview source). Until alt meats improve, it is likely that they will continue to be viewed as a "gimmicky" product unlikely to be incorporated into habitual diets.

There is some expectation that demand for alt protein in China may differ from other international markets, although there is uncertainty about the direction this will take. Recent survey research suggests that up to 70 percent of (majority urban) Chinese consumers are willing to try alt meats (Dempsey and Bryant 2020). This percentage is higher than in many other countries, potentially because Chinese food culture is already comparatively varied and experimental. Far more research is required to understand the role that alt proteins may play in the future Chinese diet.

CURRENT DIETARY CHANGE INITIATIVES IN CHINA

Government initiatives

The Chinese government is already undertaking various activities to promote healthier food choices across the country. Table 1 provides an overview of some of the major nutritional policies and campaigns led by the state, in addition to broader health and lifestyle campaigns that incorporate action on food.

Although wide ranging in their targets, not all the policies outlined in Table 1 have comprehensively addressed the link between food choices and their environmental impacts. This reflects current priorities in China of establishing food security and promoting health, over and above sustainability. Yet adherence to the CDGs could enable the Chinese government to realize a triple win on all three parameters. Indeed,

TABLE 1 | Summary of major nutrition-related policies led by the Chinese government

POLICY	ISSUED IN	FOOD-RELATED ACTIVITIES
"Outline of Food and Nutrition Development in China (2014–20)"	State Council of China (2014)	**Significance:** The programmatic document on China's food and nutrition development **Key content:** ▪ Improve food quantity and quality ▪ Develop a modern and healthy food industry system using market mechanisms ▪ Inherit the tradition of plant-based foods as the main component of the diet, supplemented by animal-based foods ▪ Effectively combine guidance and intervention
"Healthy China 2030" Plan Outline	State Council of China (2016)	**Significance:** The top-level design of China's health development **Key content:** ▪ Carry out in-depth research on food nutrition evaluation ▪ Develop dietary guidelines for different groups of people ▪ Establish and improve the nutrition monitoring system and implement nutritional interventions in key areas and groups ▪ Build healthy canteens and healthy restaurants
National Nutrition Plan (2017–30)	State Council of China (2017)	**Significance:** Supports the implementation of "Healthy China 2030" and the basic framework of China's nutrition policy **Key content:** Seven implementation strategies: ▪ Improve the nutrition standard and regulatory framework ▪ Strengthen capacity building in nutrition ▪ Strengthen nutrition and food safety monitoring and assessment ▪ Develop the food nutrition and health industry ▪ Intensify the development of traditional services for maintaining health with food ▪ Strengthen shared utilization of basic data on nutrition and health ▪ Popularize knowledge regarding nutrition and health Six major actions: ▪ Action on nutrition and health in the first 1,000 days of life ▪ Action to improve student nutrition ▪ Action to improve nutrition for the elderly ▪ Action on clinical nutrition ▪ Nutrition intervention in poor areas ▪ Action on balancing diets and physical activity

TABLE 1 | Summary of major nutrition-related policies led by the Chinese government (Cont.)

POLICY	ISSUED IN	FOOD-RELATED ACTIVITIES
"Chinese Dietary Reference Intakes"	NHC (2017)	**Significance:** Provides a scientific basis for developing national food nutrition development plans and nutrition-related standards **Key content:** ▪ Specified intake reference values for different age and gender groups for energy requirements, protein, fat, carbohydrates, vitamins, and minerals
Guidelines for Nutritional Labeling of Catered Food	NHC (2020)	**Significance:** Government technical guidance for the catering industry on nutritional labeling **Key content:** ▪ Encourage labeling of the nutrition reference values (NRVs) ▪ Encourage adding to menus the statements "adult's daily energy requirement is 2,000 kcal" and "adult's daily salt intake should not exceed 5 g" ▪ Unify the nutritional labeling format of catered food
"National Food Safety Standard: General Rules for Nutrition Labeling of Prepackaged Foods"	NHC (2011 [revised 2021])	**Significance:** Mandatory national standards **Key content:** ▪ The use of NRVs ▪ More details on protein, fat, and carbohydrate content ▪ Adding serving size ▪ Adding warning labels for high sugar, fat, and salt for young and elderly groups
Chinese Dietary Guidelines (2022)	CNS (2022)	**Significance:** Contents reflect the consolidated views and positions on diet and health of academics and health management departments and are considered essential to achieving public health goals in the country **Key content:** ▪ Enjoy a varied and well-balanced diet ▪ Be active to maintain a healthy body weight ▪ Eat plenty of vegetables, fruit, dairy, whole grains, and soybeans ▪ Eat moderate amounts of fish, poultry, eggs, and lean meats ▪ Limit foods high in salt, sugar, and cooking oil; avoid alcoholic drinks ▪ Maintain healthy eating habits and drink adequate amounts of water ▪ Learn nutrition labeling, shop wisely, and cook smart ▪ Pay attention to dietary hygiene, serve individual portions, and reduce food waste

Source: Summarized by the research team.

important linkages between health, environment, and food security are increasingly recognized in China, as reflected in President Xi's "Big Food" vision, communicated in 2022. This clearly points to the need to diversify agricultural production based on available resources and environmental carrying capacity to meet changing population demand.

Third-sector initiatives

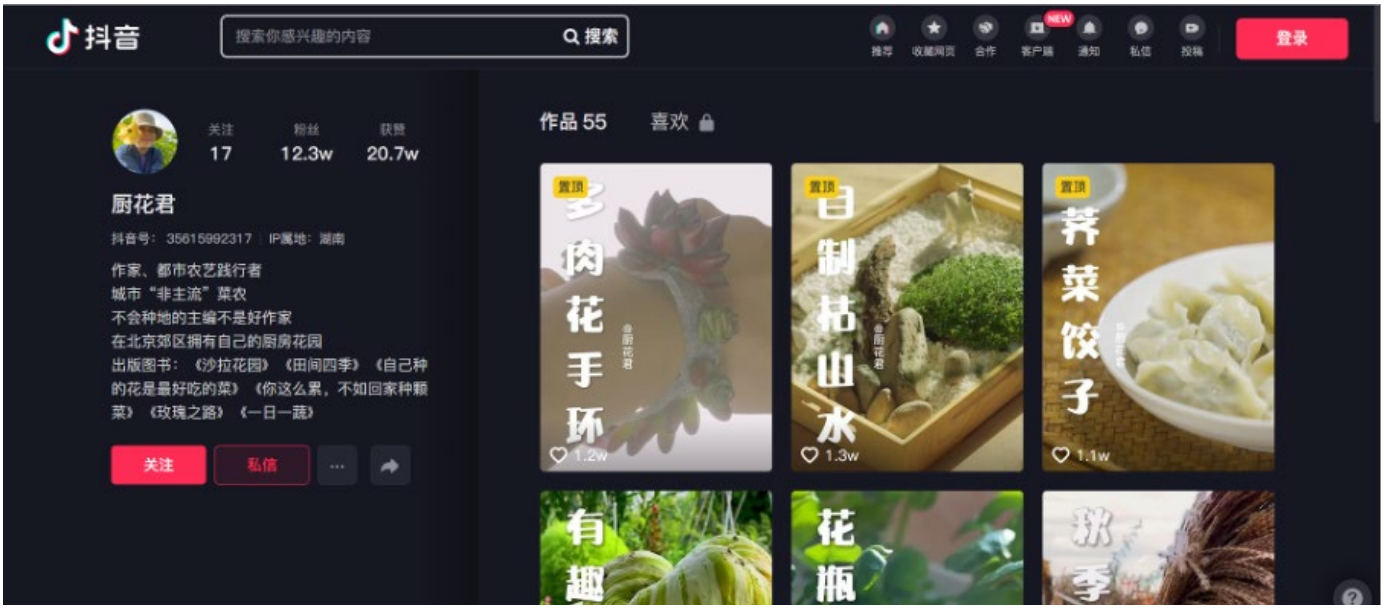
While the government plays a critical role in promoting population behavior change in China, successful actions to encourage healthier and more sustainable food choices have already been taken by various third-sector organizations (i.e., nongovernmental organizations [NGOs]) working in the country.

For example, GoalBlue, a Chinese NGO established in 2016, has sought to promote more sustainable lifestyles in China by targeting shopping, commuting, and food choices. One of GoalBlue's major mechanisms to create change is social media, where it works closely with influencers to promote more sustainable lifestyles through curated content released to over 13.5 million viewers on TikTok and Weibo (see Figure 6). So far, the organization has worked on diet-related topics to encourage nutritional balance and adherence to dietary recommendations.

Established in 2017, the Good Food Fund (GFF) is a nonprofit initiative connecting the dots in food systems to promote healthy and sustainable consumption patterns in China. Through a series of innovative projects, GFF serves as an action hub that engages a wide range of food systems stakeholders. It designs and organizes trainings for chefs, hospitality professionals, city managers, educators, young people, and community leaders so they can change public discourse on food systems transformation. The related GFF online training courses have had more than 650,000 total views to date (see Figure 7).

The Food and Land Use (FOLU) Coalition is also active in China. FOLU is dedicated to a food and land use systems transformation through strengthening the scientific and economic evidence base and demonstrating impact through local pilots and multistakeholder approaches. Promoting sustainable and healthy diets is one of the coalition's priorities. Most recently, FOLU partnered with the Meridien Institute to publish a report identifying opportunities to accelerate a shift toward healthy and sustainable diets in China. The report outlined recommendations for different stakeholder groups, such as government and policymakers, researchers and academia, businesses and investors, and civil society and social innovators, with the overarching goal of aligning the agendas of all parties in order to accelerate change (Meridien Institute and FOLU 2023).

FIGURE 6 | Sample of GoalBlue social media posting



Source: TikTok account of GoalBlue Low-Carbon Influencer Program.

FIGURE 7 | Ad for “Ecochef” training course

Source: Good Food Fund.


EAT
EAT

CHAPTER 2

Changing food choices in China

Achieving greater adherence to the 2022 CDGs requires a clear understanding of what drives choice-making around food in China. In, addition to sociodemographic characteristics, a wide range of other individual- and environmental-level factors also influence food choices, many of which are unique to the Chinese context and are explored in this section.

DRIVERS OF FOOD CHOICE IN CHINA

Food environment

According to a growing body of behavioral science research, the food environment surrounding individuals is the preeminent influence on their eating habits. This includes the availability of retail and food service outlets, as well as the type of food on offer, its relative cost, advertising, and placement (Attwood et al. 2020). China is no exception, with research demonstrating that the availability and convenience of local food retail options, particularly those stocking fresh fruit and vegetables, determines the quality of the diet (Cheung et al. 2021). In general, consumers tend toward habitual shopping patterns, returning to the same vendors (Cheung et al. 2021).

One major difference concerning the food environment in China compared to other industrialized countries, however, is the degree of fragmentation in the retail market (Woetzel 2019). In the United States, for example, the choice of shopping outlets is relatively homogenous, monopolized by fewer, larger supermarket chains (interview source). In China, consumers tend to purchase food from a far wider range of enterprises, including traditional e-commerce platforms (e.g., Tmall Fresh, JD Fresh, Benlai), online-to-offline offerings (e.g., JD Daojia, Meituan Flash Sale), front warehouse modes (e.g., Meituan, Maicai), store-warehouse integration (e.g., Hema Xiansheng), and community group buying options (e.g., Xingsheng Selected, Duoduobuy), as well as more traditional local community, wet (selling meat, fish, and fresh produce), night, and street markets (interview source).

Figure 8 depicts projected sales growth and compound annual growth rate across different food retail channels in China, showing that traditional formats (e.g., street vendors, food markets, mini markets, kiosks, and other independent or small stores) remain the largest sector overall, but rapid rises are expected in channels that offer consumers quick and easy service, such as online shopping and convenience stores (IGD 2021).

China is currently home to the biggest online grocery market in the world (Good Food Institute 2018), with recent years seeing rapid expansion into rural areas and lower-tier Chinese cities. This has significantly altered food availability in these previously underserved areas. The COVID-19 pandemic has further accelerated this trend. Online grocery sales increased by 20 percent at the peak of the crisis, with over half of new consumers saying they would continue shopping online in the long term (Woetzel 2019).

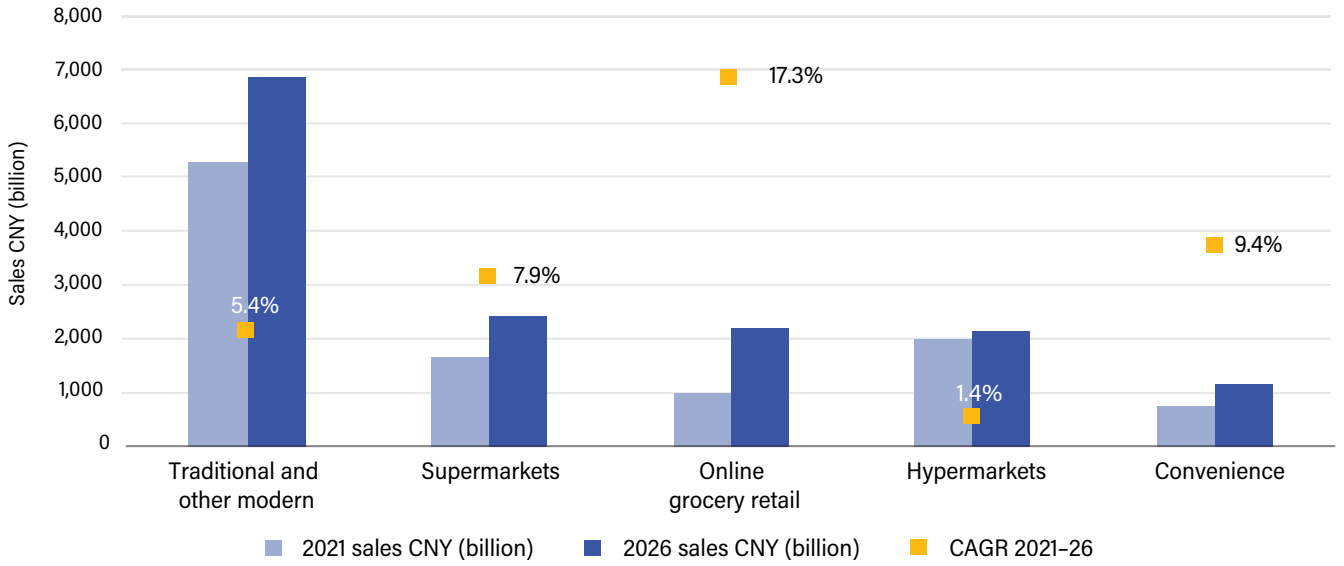
For many Chinese consumers, local fresh or wet markets and supermarkets are primary sources of produce, with proximity to these outlets linked to greater consumption of fruit and vegetables. In general, produce from markets is seen as fresher and cheaper, but produce from supermarkets is deemed safer and of higher quality, owing to the standards supermarkets implement and the certification labels they use (Cheung et al. 2021; Ortega et al. 2015).

For a further discussion of the role of the food offering itself in influencing consumer choices, see Subsection 3.3 on Product.

As the average income of Chinese citizens rises, dining out-of-home is becoming more common. Data from 2015 suggest that the average Chinese citizen now eats out around 2.6 times per week (Wei et al. 2022). China's hotel, restaurant, and institutional dining sectors recorded $573 billion in sales revenue in 2020, a decline of around 15 percent from pre-COVID 2019 data (USDA 2022). Full-service restaurants (i.e., where table service is provided in situ) remain the most common type of food service establishment, although China has experienced a rapid rise in home delivery via online platforms in recent years, partly catalyzed by COVID-19 lockdowns and associated restrictions on dining out (McKinsey and Company 2020).

Online food delivery is particularly popular among younger age groups (around 40 percent of online users are between 18 and 25 years old) and white-collar workers who value the convenience that this service brings (Maimaiti et al. 2018). Institutional catering (workplace canteens, hospitals, government offices, army, schools, etc.) also accounts for a sizeable share of the sector, representing around 15 percent of revenue from food service and hospitality as a whole (China Agricultural Trade Offices 2018). Dining out in company or school

FIGURE 8 | Sales growth by different grocery channels in China



Notes: CAGR = compound annual growth rate; CNY = Chinese yuan.

Source: IGD (2021).

canteens at lunch is commonplace in China, while breakfast is more frequently consumed in restaurants than are evening meals (Zang et al. 2018).

Overall, eating away from home is more prevalent for Chinese citizens with higher incomes based in urban centers, for men, the more educated, and the unmarried (Zang et al. 2018). As with retail, the restaurant sector in China is highly fragmented, with a preponderance of small and medium-sized enterprises serving a diversity of regional cuisines. While the popularity of international food is growing in China, particularly in cafés and coffee chains frequented by younger urban Chinese, out-of-home dining is still dominated by Chinese food offerings, especially in tier 2 and 3 cities (China Agricultural Trade Offices 2018). When dining out, the practice of sharing meals is prevalent, with a strong preference for a wide variety of dishes to be ordered and shared with fellow diners at mealtimes, rather than individuals' selecting and consuming their own dishes, as is the norm in many Western countries (interview source).

The types of foods eaten out-of-home differ from those consumed in-home in China, with the former often including more ingredients considered unhealthy if consumed in excess, such as meat and salt, and the latter higher in vegetables (Bai et al. 2020). Recent research has identified a significant positive link between the variety, density, and proximity of food service outlets and rising obesity rates in China (An et al. 2019). For example, an analysis of Shanghai residents' food intake patterns shows greater intake of calories and fat among diners who regularly consume institutional catering, while those who frequently eat in restaurants consume more sodium (Zang et al. 2018). Other data, however, have shown that, contrary to common assumptions, food from online delivery is not always necessarily unhealthy, with set meals (e.g., with rice, meat or eggs, and vegetables as the main components), noodles, and dumplings accounting for nearly 80 percent of all meals ordered online (Cong et al. 2022).

Yet other health issues are linked to the rise in online food delivery in China, such as excess sedentariness as people leave home less to go to grocery stores, markets, and restaurants (Fernandez and Raine 2021). Moreover, food delivery is associated with environmental concerns, particularly linked to excess packaging and plastics that accompany delivered meals (Maimaiti et al. 2018), while more frequent dining out in general may exacerbate food waste (Li et al. 2022), which has drawn policymakers' attention.

Media and advertising

Food environment refers not only to food retail and service outlets but also to the media ecosystem surrounding us and our degree of exposure to food advertising.

As in all countries, food advertising in China is uniquely tailored to Chinese consumers' needs, interests, and cultural norms. For example, one recent analysis comparing the content of television advertising for local Chinese brands versus international brands found the former more likely to use associations between positive eating experiences and communal dining—a norm in China—whereas global brands were more likely to link positive eating with solitary dining—a practice more typical in the West (Chang et al. 2018a). Also increasingly common in China are advertisements for foods endorsed by opinion leaders, celebrities, or family elders, in line with the value placed on authority figures in Chinese culture.

Beyond television, advertising on social media is also a major influence on food choices in China, particularly among younger, Gen Z consumers. In a 2021 survey by McKinsey and Company, 51 percent of Gen Z consumers cited social media accounts as one of the top three sources of influence over their purchase decisions (Woetzel 2019). In 2020, WeChat remained the most popular social media platform in the country, reaching over 1.2 billion monthly active users (GMA 2022), while Douyin (TikTok) continues to attract a rapidly growing user base of younger Chinese.

Consumer attitudes and perceptions

The Chinese are increasingly motivated to purchase healthier food, with a 2019 survey finding around three-quarters of the population interested in pursuing a healthier, more sustainable lifestyle (Qi and Ploeger 2021). This rise can be partially attributable to the COVID-19 pandemic, which has enhanced public awareness of the link between food choices and health. For example, one 2020 research study in China found that the pandemic led to more positive attitudes toward eating healthy and organic produce and more negative attitudes toward consumption of game meat (Xie et al. 2020).

In addition to concerns about the healthiness of food, overall food safety is also a prominent consideration for Chinese consumers (Ortega et al. 2011). This is due in part to a series of food-related scandals, including the melamine-tainted milk powder incident, the gutter oil outrage involving sales

of repurposed restaurant sewer refuse, and sales of illegal or contaminated meat products (Good Food Institute 2018). As a result, the Chinese public is more likely to limit food purchases to products from trusted providers with official labeling (Cheung et al. 2021).

Cultural factors

Many aspects of Chinese culture contribute to unique regional eating norms, including the infusion of beliefs from traditional Chinese medicine (TCM), collectivist attitudes, China's "banquet" culture, and the multitude of food-related observances associated with the country's major religions.

TCM takes a more holistic approach to health than does Western medicine, incorporating beliefs and rules regarding food, which have influenced Chinese food preferences over time. Examples include adding specific herbs to dishes to create therapeutic cuisines, associating certain ingredients with properties that they transmit to the consumer, or a belief that vegetarian food supports longevity. Traditional Chinese medicine also stresses the importance of food freshness, as well as eating in moderation (Wang-Chen et al. 2022).

Chinese culture is often described as more collectivist than that of other industrialized nations, meaning a greater tendency toward conformity to the group and less emphasis on individual needs, wants, and desires. This orientation has been demonstrated to influence food choices, with research showing strong motivations to comply with group eating norms in China and more potential for food purchases to be influenced by recommendations from acquaintances or other reference groups (e.g., online review communities) (Qi and Ploeger 2021). In communal dining settings, and especially when dining with family, politeness, obedience, and unwillingness to disrupt group harmony are considered paramount in Chinese culture. These values, derived from the Confucian belief system, can lead to overconsumption of certain foods if individual diners are reluctant to express food preferences that deviate from the group norm (e.g., wishing to consume only plant-based dishes during a meat-rich family meal) (Wang-Chen et al. 2022).

Chinese banquet culture is cited as a further influence on regional food consumption patterns, with social events often associated with lavish, excessive dining (Woetzel 2019). Serving meat is also considered a sign of Chinese hosts' prosperity and respect for their guests.

CHAPTER 3

A behavior change playbook for the Chinese context

In 2020, WRI published the *Playbook for Guiding Diners toward Plant-Rich Dishes in Food Service*. In this section, we consider the behavioral interventions listed in this playbook through a Chinese lens.

We contextualize the 57 individual change techniques from the original playbook to China and consider their relevance in light of the major insights on eating habits in the region in this section.

WRI'S FOOD SERVICE PLAYBOOK

In 2020, WRI published the *Playbook for Guiding Diners toward Plant-Rich Dishes in Food Service*. This guide detailed a list of interventions, informed by behavioral science, to encourage consumers to choose more sustainable and healthier options when dining out (Attwood et al. 2020).

The choice of interventions listed in the playbook was inspired by the findings from a systematic literature review. These interventions were subsequently prioritized by a group of industry stakeholders, who judged each approach according to its potential impact and the feasibility of implementing it in the real world. In total, 57 behavior change interventions were identified, clustered into five broad categories (the "5Ps") depending on the target of each intervention.

The results of the prioritization exercise are shown in Figure 9 below (see Appendix B for details of the intervention referred to by each code listed in Figure 9—PRS1, PRS2, etc.). In the highlighted top right-hand quadrant are the 23 "best bet" interventions that stakeholders considered most impactful and easiest to implement (Attwood et al. 2020).

In the remainder of this report, we use this framework as the basis for targeted recommendations on how to promote greater adherence to the CDGs in China. However, while this guide has proved useful for food service organizations, predominantly based in the United Kingdom and United States, there are some limitations to its direct application to China, and especially to rural areas, where dining contexts vary considerably.

First, the interventions plotted in Figure 9 are relevant to food service contexts only. While many of the behavior change principles underlying these approaches do apply to alternative food environments, including markets, supermarkets, and online purchasing, the playbook does not explicitly list these.

Second, the 57 approaches identified were informed by primarily Western literature, with none of the research included in the original systematic review originating in China. As a result, there is no existing evidence to determine whether interventions in the list are also applicable to Chinese food service environments.

As a result, in the remainder of this report, we consider the behavioral interventions listed in the original playbook through a Chinese lens—that is, we contextualize the findings, including the list of 57 individual change techniques, to China and consider them in light of the major insights regarding eating habits outlined in Sections 1 and 2 of this report. We discuss these in the next six subsections, offering further recommendations and key findings for each of the 6P areas explored in the text.

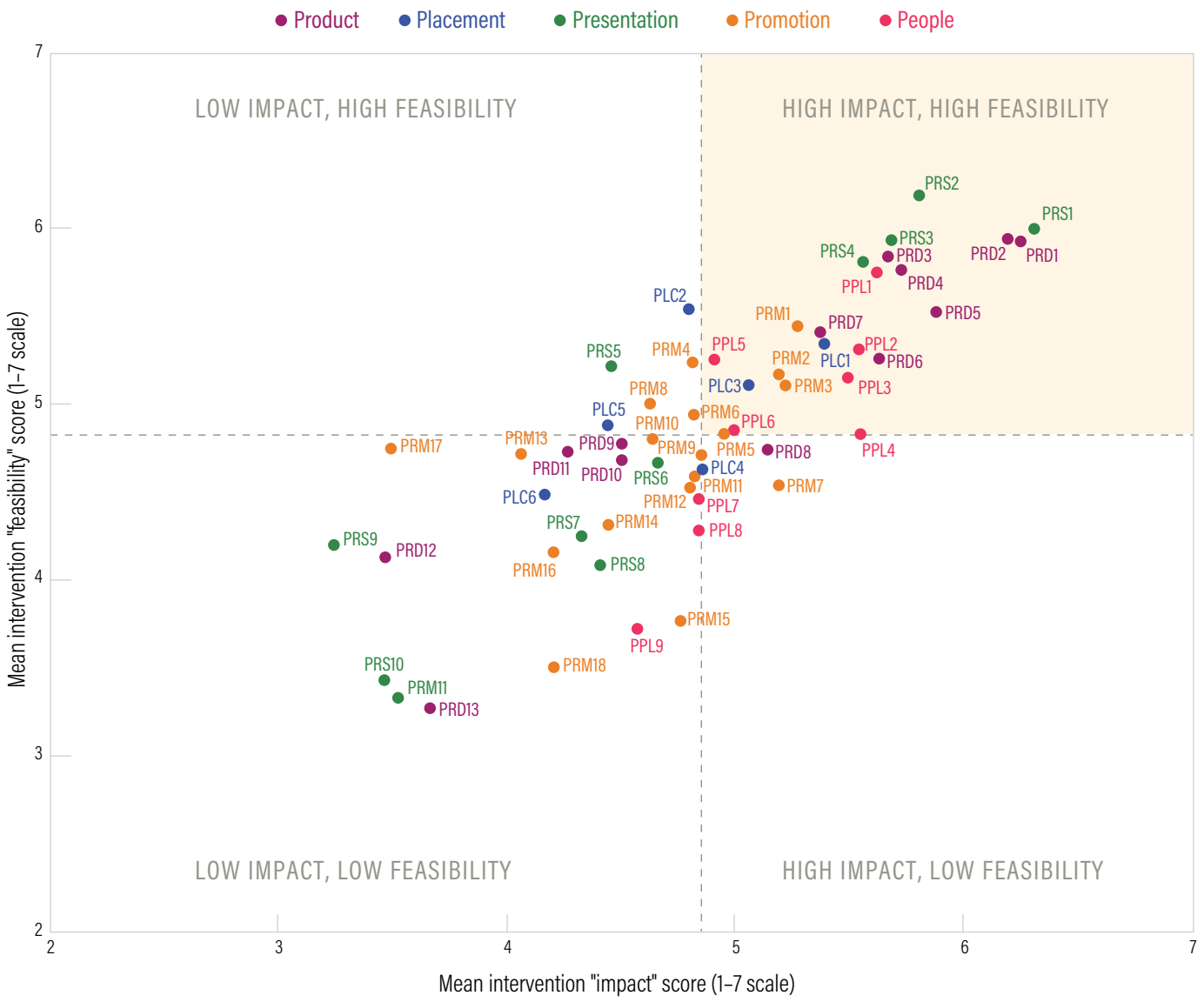
Here, we focus on food culture in urban areas, where around 60 percent of the Chinese population resided in 2019 (World Bank 2019). Based on this, we present an updated behavior change framework for China, with a deep dive into each group of interventions.

Behavior change target areas for China

As we considered possible applications of the food service playbook in China, it immediately became evident that one major target area was missing: policy interventions. This refers to behavior change interventions delivered by the Chinese government (see Figure 10).

Policymakers are important stakeholders in any effort to influence population behavior in China, given the state's influential role and its jurisdiction over Chinese citizens' day-to-day lives. Regarding health and food choices specifically, Chinese people view the government as a respected and trusted source of information (Ortega et al. 2012).

FIGURE 9 | Joint feasibility and impact rankings of the 57 behavior change interventions identified in WRI's food service playbook



Notes: PLC = Placement; PPL = People; PRD = Product; PRM = Promotion; PRS = Presentation.

Source: Attwood et al. (2020).

FIGURE 10 | "6P" behavioral framework to promote adherence to the Chinese Dietary Guidelines

Source: Adapted from Attwood et al. (2020).

PEOPLE

Behavior change interventions that promote healthy, sustainable options by engaging food salespeople, servers, experts, and influencers

People considerations for the Chinese market

While a wide variety of healthy, sustainable options are already available to Chinese consumers in retail and food service, many of these are traditional vegetarian dishes that are not optimized or specifically marketed for their health-giving or environmentally friendly attributes (Good Food Institute 2018). People who work in the food sector could therefore respond to growing consumer interest in health, wellness, and the environment by innovating and marketing new products and dishes that explicitly address these concerns.

Chefs, restaurant managers, product developers, food bloggers, and influencers all have the potential to develop new and exciting recipes, formats, and presentations of healthier, more sustainable meals, acting as catalysts for the diffusion of these food innovations to the wider population. While chefs are not necessarily regarded with the same esteem in China as in some Western countries, this perception is slowly changing, meaning that chefs, like restaurant managers and food business owners, may be able to influence their clientele's food choices in the future (interview source). Providing these individuals, particularly management, with targeted training on how to prepare and upsell dishes that are in line with the CDGs—namely, those high in fruit, vegetables, eggs, whole grains, and dairy—could boost the appeal of these options. Targeted training and promotion of an organizational culture that seeks to prevent food waste are also valuable actions.

Medical professionals and other health professionals, such as registered dietitians, can also play an important role in promoting healthier and sustainable food choices in China, amplifying key messages, advising at-risk groups, and acting as role models for positive eating habits.

Beyond this, we also note the opportunity to engage the "chef" within a family group. In many cases, this is the "housewife" or primary caregiver, who can influence the behavior of other family members. This includes dictating which foods are prepared and eaten in-home, as well as the dining norms for the whole family. As we have already noted, communal dining and sharing of dishes is more common in China. This means that interventions targeting the most influential family member can lead to conformity

across all members (Wang-Chen et al. 2022). Examples of the types of approaches to encourage housewives or other family influencers to promote food choices in line with the CDGs include providing nutritional education, food preparation skills training, cash transfers or other incentive programs, increasing credit support to facilitate purchases of healthier, sustainable options, offering discounts on selected ingredients or cooking equipment, or setting up local support groups to enable exchange of ideas, recipes, and nutritional advice.

Example People interventions

(Please refer to Appendix B to cross-reference intervention codes to Attwood et al. 2020)

- **PPL1:** Providing those who prepare food (i.e., chefs, primary care providers, food product developers) with information about the CDGs
- **PPL2:** Developing training for those who prepare food on how to make healthier, more sustainable, and tasty dishes in line with the CDGs
- **PPL3:** Encouraging food servers (i.e., wait staff, cashiers) to try the healthy, sustainable dishes they sell, in order to be in a better position to recommend these to customers
- **PPL4:** Ensuring that those who prepare food have access to the right tools, equipment, and ingredients to prepare meals in line with the CDGs
- **PPL5:** Rewarding chefs who create popular new dishes that are both healthy and sustainable
- **PPL6:** Providing food servers with talking points to selectively promote healthy, sustainable dishes from the range of options available
- **PPL7:** Creating a peer network for chefs and food product developers using social media, to encourage sharing of ideas, recipes, and innovations, and to receive support and feedback
- **PPL8:** Training food servers to praise diners who select healthy, more sustainable options that adhere to the CDGs
- **PPL9:** Offering food servers financial, material, and social incentives to upsell healthy, sustainable dishes and products

PRODUCT

Approaches that promote healthy sustainable options by modifying the type and range of food on offer

Product considerations for the Chinese market

One major product-related consideration for China is the need to further incorporate sustainability considerations into the CDGs. Innovations in data science can optimize environmental parameters by applying algorithms to food consumption data, calculating ways to modify existing food intake patterns to enhance consumption of specific nutrients, or to reduce GHG emission footprints. These innovations could be applied to Chinese food intake data, capping total environmental impact and specifying nutritional parameters, to develop region-specific, healthy, and sustainable dietary recommendations (Chaudhary and Krishna 2019). In China, this approach will need to go beyond the national level to consider regional variations in food choice, given that taste preferences, cuisine types, and access to ingredients vary considerably across the country. For the first time, the 2022 CDGs cite the Jiangnan regional diet as the main reference guide for the "Oriental Healthy Diet" (CNS 2022), but they have not yet cited examples of how other regional cuisines can be modified to improve their health profile, particularly in terms of reducing oil and salt content.

Common plant-based foods could be promoted following CDG recommendations, especially for dining out-of-home. One example is tofu, already a widely consumed source of protein but not routinely used as a replacement for meat in Chinese meals (Ortega et al. 2022). Instead, both tofu and meat are frequently eaten together in a dish. There is therefore an opportunity to encourage either a direct switch (away from meat only, or meat and tofu, to only tofu) or to develop dishes where part of the meat content has been replaced by tofu or other plant-based sources of protein. This approach is referred to as "blending" and works well for dishes where meat is already mixed with other ingredients, as in dumpling fillings. Alternatively, dishes rich in plant-based content could be served as the default option in restaurants, with consumers given the option to add a diverse range of protein sources. For a full list of example Product interventions drawn from WRI's food service playbook, see the bulleted list below.

In China, more research is needed to better understand the potential risks and benefits of adopting more novel alternative protein sources (see Box 3 for further details on "alt meat" specifically). To date, consumer perceptions of certain types of alternative proteins, such as cultivated meat and insect-based variants, are mixed. Further work is required to determine the true value, healthiness, and safety of these products for Chinese consumers before widespread adoption is likely.

Example product interventions

(Please refer to Appendix B to cross-reference intervention codes to Attwood et al. 2020)

- **PRD1:** Moderating the amount of overconsumed ingredients in a dish (according to the CDGs), while increasing the amount of underconsumed ingredients
- **PRD2:** Improving the flavor or texture of healthy, sustainable dishes and products
- **PRD3:** Introducing campaigns to promote one day per week dedicated to eating foods recommended in the CDGs; for example, vegetables, whole grains, eggs, and dairy
- **PRD4:** Improving the appearance of healthy, sustainable dishes and products
- **PRD5:** Increasing the variety of healthy, sustainable dishes and products on offer
- **PRD6:** Increasing the relative ratio of healthy, sustainable dishes to more than 75 percent of the overall offering
- **PRD7:** Introducing healthier, more sustainable direct substitutes for foods to be consumed in moderation according to the CDGs
- **PRD8:** Developing new, or improving existing, accompaniments to healthy, sustainable options
- **PRD9:** Reducing the overall portion size of meals to prevent overconsumption
- **PRD10:** Reducing the size of the plate or bowl used to serve a meal, to prevent overconsumption
- **PRD11:** Blending plant-based ingredients into meat-based dishes to diversify food choices, in line with CDG recommendations
- **PRD12:** Adding visible decorations to healthy, sustainable restaurant meals, to attract the attention of other diners and highlight the popularity of this option
- **PRD13:** Introducing specially designed utensils or novel packaging to improve the experience of eating healthy, sustainable options

POLICY

Approaches to promoting healthy, sustainable options through government policy and actions

Policy considerations for the Chinese market

According to interviewees, the government is considered *the* entity to engage if behavior change efforts are to achieve success at scale in China. Examples of the types of interventions the government could consider to influence population food choices are listed in the bullets below, informed by our expert interviews.

While many state initiatives have focused on promoting healthy food choices, few have explicitly linked eating habits to climate change or environmental sustainability (see Table 1). One major exception is the government's focus on food waste; Box 4 outlines a successful state-driven intervention targeting this issue in China. The Chinese government has, however, developed a number of policies concerning the production and consumption of low-carbon products more broadly, including the "14th Five-Year Plans Relating to the National Economic and Social Development and Vision 2035 of the People's Republic of China" (CPC Central Committee 2021), the "Action Plan for Carbon Dioxide Peaking before 2030" (State Council of China 2021b), the "Plan for Agricultural and Rural Modernization" (State Council of China 2021a), the "Plan on Agriculture Green Development" (MARA 2021), and the "Implementation Plan for Promoting Green Consumption" (NDRC 2022).

Government priority-setting is heavily evidence-based in China. Hence, to raise the profile of healthy and sustainable food, more national research is needed. This could include testing behavior change approaches proven to work in international settings in China, trialing novel interventions designed specifically for Chinese retailers and food service providers, and more widespread translation and dissemination of English- and other-language research on the topic of dietary behavior change.

Efforts to reach consensus among Chinese academics and other stakeholders regarding the definition and importance of healthy, sustainable eating patterns may also help drive this issue higher up on the list of government priorities in coming years. In conjunction, innovation and experimentation by Chinese food businesses can attract further attention. The private sector can play an important role by bearing the risk and costs of novel food development, and by demonstrating to policymakers that Chinese consumers are receptive to healthy and sustainable options. The private sector can also shift demand by better advertising the health- and sustainability-promoting credentials of their products, thereby pushing these issues to the front of consumers' minds. This may lead to greater public advocacy and stronger calls for more government support to promote sustainable food choices.

Successful government action on food choice in China will need to involve an integrated policymaking approach, drawing on interdisciplinary research (Meridien Institute and FOLU 2023). This could include establishing an interministerial coordination mechanism that encourages the integration of nutrition, health, and sustainability into a wide range of policies and plans. More interdisciplinary research could also strengthen collaboration with business, industrial associations, and cooperation platforms. Value could also be derived from further international and multilateral collaboration, facilitating the sharing of strategies to promote healthier and more sustainable food choices between China and other countries.

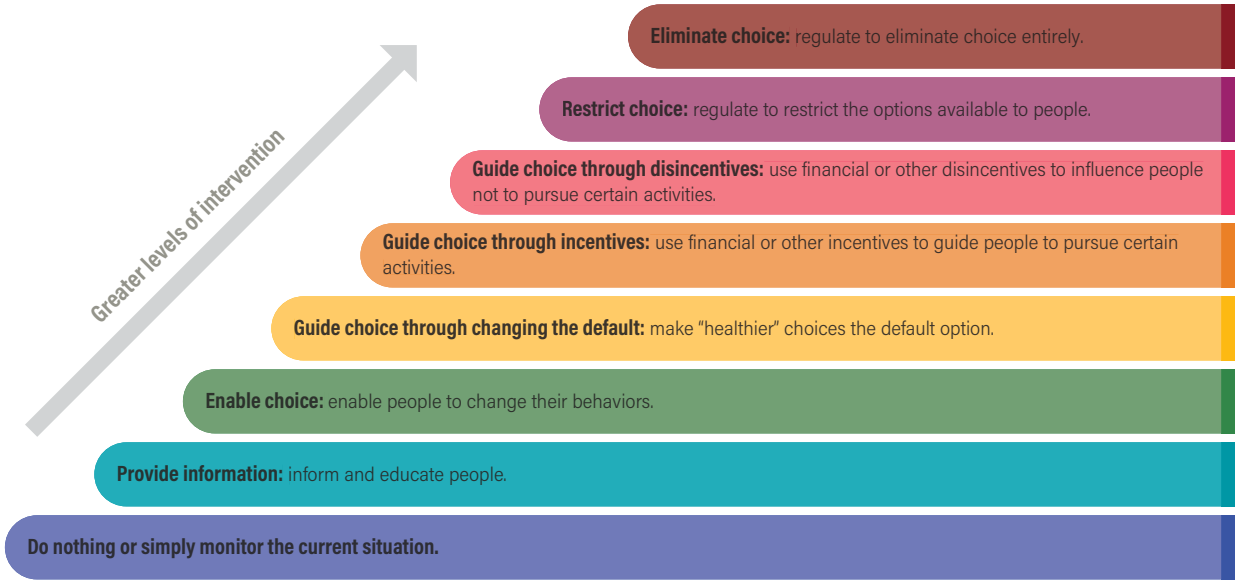
Our expert interviews suggest that one of the most effective levers that Chinese policymakers can use to influence food choices involves price—that is, reducing the cost of foods recommended in the CDGs, like fruit and vegetables. Here, the overriding goal is to ensure that fresh, quality produce is affordable to all Chinese citizens. In particular, financial support or food stamps for rural populations may encourage healthier and more sustainable food choices in lower-income communities, with one recent analysis indicating the potential for an income transfer policy of 20 percent to low-income rural residents to boost intake of insufficiently consumed foods such as fruit and vegetables, aquatic products, and milk by 8.4, 3.6, and 4.9 percent, respectively (AGFEP 2022).

Public food procurement is another mechanism that the government could consider to promote adherence to the CDGs. This includes purchasing and service of food for public universities, hospitals, prisons, and other social projects,

BOX 4 | A Chinese policy on food waste reduction success story

Reducing food waste has been a policy priority in China for some time, both from the perspective of supporting food security goals and as an important means to promote better nutrition. Reducing loss and waste of highly nutritious foods that may otherwise easily rot or spoil (e.g., fruit and vegetables, milk, or aquatic produce) increases the amount of nutrients in the food supply available to support population health (AGFEP 2022). The Chinese government has backed various successful initiatives to reduce food waste, demonstrating the wide range of levers at its disposal when tackling a priority issue. From the perspective of behavioral science, these span a commonly cited "ladder of interventions" (see Figure B4.1), which summarizes approaches to changing behavior that range from less to more directly restrictive.

FIGURE B4.1 | Ladder of intervention approaches to encourage behavior change



Source: Walls (2015).

In one of the less-intrusive approaches listed near the bottom of the ladder, informing and educating people, the Chinese government has partnered with the nonprofit organization IN_3 to launch the "Clean Your Plate" campaign. This involved circulating posters and flyers with slogans such as "Starting with me, no leftovers today" in restaurants and gas stations and a popular campaign on the social media platform Weibo, which garnered media attention and led to participation by cities and restaurants across the country.

Moving up the ladder to more restrictive approaches, the Chinese government has enabled the population to waste less food by introducing disincentives and default interventions, working with the food service industry. This includes the "n – 1" ordering model, where groups who share dishes when dining out are encouraged to order one less dish than the number of people in their group (Figure B4.2), restaurants are encouraged to offer diners half-size servings, and buffet guests are penalized for leaving leftovers (Koetse 2020).

Toward the top of the intervention ladder, where the most restrictive but generally most effective approaches are positioned, the Chinese government introduced anti–food waste laws in 2021. These include regulations on grain storage to prevent spoilage, on animal feed practices to save grain, and on the catering industry, including fining consumers who leave excess uneaten food. Also introduced was a ban on posting social media videos of binge eating (the practice of Mukbang), and heavily fining those who flout this restriction (NYCFPC 2021).

FIGURE B4.2 | An example of the n – 1 guidance

Source: Zhuhai Dandelion Nutrition Health Promotion Center.

which make up around 15 percent of the revenue of China's total dining-away-from-home sector (China Agricultural Trade Offices 2018).

Focusing on promoting healthy, sustainable food choices through institutional dining can be an effective entry point for numerous reasons; first, as we have already noted, the population consuming public meals in China is large. Second, young people constitute a sizeable proportion of this population, especially in schools and universities. This is useful not only because younger Chinese are more receptive to messaging on health and sustainability than older generations, but also because instilling eating habits earlier in life can lead to positive changes that extend across a lifetime. Third, this approach is well evidenced in other countries that have implemented similar programs, such as French regulations to ensure that more plant-rich options are available to students (Stares 2021).

A new national nutritional campaign that incorporates messaging on food sustainability may also prove beneficial in China. Given the low levels of awareness of this issue, a campaign of this type would likely be a necessary step, yet insufficient on its own, to create population-level change. While campaign messaging can pique consumer interest in healthy, sustainable food choices, actual changes may only follow if consumers are also surrounded by an enabling environment in which better food choices are easily available and taste good (Marteau et al. 2021).

Example policy interventions

(all listed techniques are new additions)

- **POL1:** Developing and disseminating population nutrition campaigns that promote adherence to the CDGs and incorporate information on the environmental impact of food choices
- **POL2:** Providing food stamps or financial support to poorer communities to boost purchasing of foods that the CDGs recommend consuming in higher quantities
- **POL3:** Introducing subsidies for foods that the CDGs recommend consuming in higher quantities
- **POL4:** Implementing health and sustainability guidelines for public food procurement

PRESENTATION

Interventions that promote healthy sustainable options by redesigning food menus, labels, and messaging

Presentation considerations for the Chinese market

For a full list of example Presentation interventions to encourage changes in eating habits, informed by WRI's food service playbook (Attwood et al. 2020), see the bulleted list below. China currently has no national-level, front-of-pack carbon footprint labeling scheme, although the "Safe, Green, Organic, Origin indications" labels are present on some food products. There are numerous reasons for this, including huge heterogeneity in food production practices across the country (making it difficult to determine a common national standard) and relatively low levels of public understanding of food labels (Jie 2017). This suggests that, without a sister education campaign (as noted in the Policy subsection), environmental labels may be widely misinterpreted by the Chinese population, and so exert minimal influence on food choices. Further work is required to develop an effective system for monitoring the environmental impacts of a wide variety of foods produced in China, followed by experimental tests to determine which label formats consumers best understand.

Where food labeling research has been conducted, Chinese consumers are found to prefer carbon labels that are colored green, that directly quantify carbon emissions, and that apply a grading system or scale to products (Jie 2017). Chinese consumers also express strong preferences for third-party certification schemes for carbon labeling, such as government-certified labels or those from foreign agencies and third-party organizations (Cheung et al. 2021; Ortega et al. 2012).

Beyond including graphics on food labels, dish and product descriptions could be modified to promote choices that support adherence to the CDGs. For example, one recent study explored the effectiveness of highlighting different consumer "valued self-identities" (healthy or environmentally aware, etc.) on food menus, finding that these can influence the appeal of plant-based alternatives such as tofu or alternative protein (Ortega et al. 2022). From the remaining literature, we have identified a series of further approaches to

describing healthy, sustainable options that may be valuable to explore in the Chinese context. These are listed in Table 2. Additional work is required to understand which, if any, of these will influence consumer food choices in China's real-world food retail and service settings.

Example presentation interventions

(Please refer to Appendix B to cross-reference intervention codes to Attwood et al. 2020)

- **PRS1:** Using language on menus, signs, or packaging that emphasizes the positive attributes of healthy, sustainable options
- **PRS2:** Listing healthy, sustainable dishes in the main body of a menu, not in a separate "vegetarian" or "healthy food" section
- **PRS3:** Using language on menus or signs to selectively recommend healthy, sustainable options
- **PRS4:** Removing unappealing language from menus, signs, or packaging
- **PRS5:** Listing healthy, sustainable options first on food menus
- **PRS6:** Using language on menus or signs to inform customers that the healthy, sustainable options are the most popular choice
- **PRS7:** Color-coding different options on menus (i.e., red, amber, green) according to which are the healthiest and most sustainable
- **PRS8:** Adding environmental footprint labels to menus, signs, and packaging
- **PRS9:** Using language or images on menus to highlight the downsides of choosing less healthy, less sustainable options
- **PRS10:** Adding attractive, natural images on menus, signs, and packages to prime users (i.e., unconsciously influence favorability) to choose dishes rich in fruit and vegetables
- **PRS11:** Offering only healthy, sustainable options on main menus, while listing all other dishes on a separate menu or one only accessible by direct request from the server

TABLE 2 | Message frames to promote healthy, sustainable food choices in China

MESSAGE TYPE	DESCRIPTION	JUSTIFICATION
Local impacts	Highlighting the local, relevant benefits of choosing a healthier, more sustainable option, such as a reduction in air pollution (Liu et al. 2021).	This messaging creates a direct, causal link between dietary choices and their consequences. Messaging about local consequences may, therefore, help to make these more salient, potentially leading to modifications in behavior. Further research is needed to ensure that this approach does not make environmental impacts appear too inconsequential and small-scale (Schoenefeld and McCauley 2016).
Multiple wins	Highlighting the multiple benefits of the CDG recommendations—for example, better health, lower environmental impact, improved food security, and great taste.	Providing consumers with many reasons to change their diet can reinforce the core message and provide multiple justifications for the same end goal, thus helping to overcome resistance (Mantzari et al. 2022). Given that Chinese consumers strongly value pleasurable eating experiences, it is likely necessary that multiple-win messaging not focus only on virtuous aspects but also emphasize the taste benefits of healthy, sustainable options (Huang et al. 2021b).
Health	Highlighting the health benefits of consuming foods as recommended by the CDGs.	Messaging on the health benefits of eating meat in moderation or increasing fruit and vegetable consumption may appeal more strongly to Chinese consumers than discussing potential environmental benefits. Health messaging can backfire, however, making consumers think that products that are good for health are less tasty. Health messages should therefore be designed and implemented with care to ensure that they have no negative spillover effects (van der Heijden et al. 2020; Huang et al. 2021b).
Doing good	Using language to emphasize that changing dietary choices in line with the CDGs will allow consumers to feel good about themselves.	Existing research in China shows greater intention to moderate meat intake when consumers anticipate that doing so will produce a positive feeling (i.e., a "warm glow") (Taufik 2018). Messaging that makes consumers feel positively about moderate meat intake thus may prove more effective than approaches that inspire negative feelings about consuming too much, such as guilt, shame, or disgust.

Note: CDG = Chinese Dietary Guidelines.

Source: Summarized by the research team.

PROMOTION

Interventions that involve promoting healthy, sustainable options using marketing, communications, and pricing strategies

Promotion considerations for the Chinese market

In China, the price at which food is sold remains one of the biggest influences over what is consumed. While surveys of Chinese consumers indicate some willingness to pay extra for foods with environmental certifications, such as organic, this has its limits (Qi and Ploeger 2021). For rural and lower-income consumers in particular, purchasing decisions are more likely to be dictated by the overall cost. This means we must ensure that foods recommended in the CDGs are priced attractively. Approaches include modifying the value proposition to make healthier, sustainable meals larger, more satiating, nutritious, or tastier for a lower price, or developing reward or points programs to redeem on healthier, sustainable options.

As noted in the Policy subsection, widespread messaging and consumer education on the CDGs is needed in China, in addition to guidance on how to make changes to food choices. Chinese food businesses can help by providing this information through their communication and advertising channels. For example, disseminating healthy and sustainable eating advice and tips on social media, in-store promotions, or websites. For other Promotion interventions from

WRI's food service playbook (Attwood et al. 2020), see the approaches listed below. Many of these can be combined to form a full suite of techniques to influence consumer choices both in-store and online (i.e., omnichannel).

For China, businesses must consider researching and developing differentiated communication strategies and messaging for different target groups, based on population profiling and segmentation. For example, providing tailored advice on food swaps for different regions based on local food preferences, modifying messaging for groups at different levels of receptivity, or promoting certain products in age groups with distinct food-related needs (i.e., convenience for younger consumers, health and lower cost for older consumers).

Social media also affords unique opportunities to advertise healthier, sustainable options, for example, through online communities and forums. In these settings, whether open or moderated, participants can share nutritional information, recipes, and healthy eating advice. In China, online reviews, in conjunction with product ratings, tend to be more heavily relied upon than in Western countries and have been shown to influence consumer decisions and willingness to pay for certain food products (Qi and Ploeger 2021; Lin et al. 2019). Regional research suggests that social networks and gaining public praise—particularly from a wider circle of acquaintances, not just close friends and family—can significantly influence food purchase decisions in China. For example, visibly purchasing organic products may act as a social signifier, indicating that the buyer has high ethical standards and can absorb the additional cost of these products (Qi and Ploeger 2021).

Regardless of the tactic chosen, Chinese policymakers and food businesses can benefit from reviewing the successes and failures of those who have already tried approaches to promote healthier, sustainable options. Given that the national conversation on sustainable food is somewhat less evolved in China than in other countries, there is an opportunity to understand which promotional tactics have worked best and which have failed for retailers and food service providers internationally, and to apply these lessons to the Chinese context. There is also an opportunity to draw on lessons learned in other public health and lifestyle initiatives within China; for example, the campaign on food waste or efforts to lower air pollution in Beijing (National Bureau of Economic Research 2020).

Example promotion interventions

(Please refer to Appendix B to cross-reference intervention codes to Attwood et al. 2020)

- **PRM1:** Offering diners free samples to taste-test healthy, sustainable dishes and products
- **PRM2:** Publicizing the environmental benefits of certain foods using marketing materials like posters, leaflets, or TV screens
- **PRM3:** Running cross-product promotions on healthy, sustainable options; for example, offering these with discounted drinks or side dishes
- **PRM4:** Publicizing the growing popularity of healthy, sustainable options among other consumers using marketing materials
- **PRM5:** Adding unhealthy ingredients as optional extras to dishes rather than included by default, possibly available at a surcharge
- **PRM6:** Encouraging individuals to act as dietary role models by actively choosing options that adhere to the CDGs when dining out with friends, family, and colleagues
- **PRM7:** Organizing cooking or food preparation demonstrations for healthy, sustainable dishes that adhere to CDG recommendations in restaurants, food retail, or online
- **PRM8:** Running multibuy or "buy-one-get-one-free" promotions for healthy, sustainable options, such as fruit and vegetables
- **PRM9:** Encouraging diners to set healthy and sustainable diet goals and to record their progress over time using a diet diary or app

- **PRM10:** Encouraging consumers to take part in healthy, sustainable dietary challenges
- **PRM11:** Offering consumers additional benefits, rewards, points, or gifts when selecting healthy, sustainable options
- **PRM12:** Providing clear recommendations on how to substitute unhealthy, unsustainable options for healthier, sustainable alternatives
- **PRM13:** Publicizing the great taste and flavor of healthy, sustainable options
- **PRM14:** Selling healthy, sustainable options at a better price than unhealthy, unsustainable options
- **PRM15:** Coordinating healthy, sustainable food promotions to tie in with national events or campaigns, such as National Nutrition Week
- **PRM16:** Providing consumers with coupons or loyalty card points to selectively redeem when purchasing healthy, sustainable options
- **PRM17:** Publicizing the health benefits of vegetables, nuts, and legumes using marketing materials
- **PRM18:** Using attractive role models, celebrities, or influencers to promote healthy, sustainable options

PLACEMENT

Interventions that promote healthy, sustainable options by changing how food is displayed and accessed

Placement considerations for the Chinese market

Given the diversity of China's food environment, Placement approaches should be chosen that are most effective for most common shopping and dining contexts. The list of example Placement interventions at the end of this subsection is informed by WRI's food service playbook (Attwood et al. 2020).

As noted in Subsection 2.1.1, China is the biggest online consumer market globally and is increasing in size, with some of the biggest shifts toward online food shopping occurring in lower-tier cities. This has opened new retail and delivery opportunities to communities not otherwise well served and helped to overcome food deserts and local food insecurity. One estimate suggests that online grocery shopping has expanded the radius of food access from an individual's home in China by around 10 kilometers (Fernandez and Raine 2021).

This shift to online has not only enabled access to a wider range of food choices but also opened new avenues to influencing consumer behavior. Online platforms allow businesses to easily reorder their food offerings. Combined with various promotion tactics, these platforms can encourage selective purchasing of healthier, more sustainable options. Examples of placement strategies to influence consumer choices through online food retail and delivery platforms include making interfaces for purchasing healthy produce easier and more intuitive to use; including more attractive images of healthy products and dishes; prefilling shopping baskets with healthy, sustainable options; encouraging consumers to preedit their choices by opting not to see unhealthy options on sale (Sandoff and Samek 2019); preordering groceries and meals in advance (Miller et al. 2016); and adding highly visible prompts to encourage beneficial food swaps (Fernandez and Raine 2021). Further research is now needed to understand which of these techniques will prove most acceptable and effective in China.

In the future, online shopping is predicted to further promote healthy, sustainable food choices to consumers through personalized and optimized shopping lists, meal kits, and food delivery services. Moreover, access to online retail and food delivery is also set to expand through introduction of transportation technologies that can span greater distances. These include driverless cars, delivery robots, and drones, the latter of which are already being tested for feasibility in another East Asian country, South Korea (Fernandez and Raine 2021).

Beyond this, physical retailers and restaurants in China also have potential to alter their layouts and food displays. The underlying placement principles of making healthy, sustainable options easier to access, more prominent, and increasingly available must be adapted across contexts (Attwood et al. 2020). For example, supermarkets can design "green food" offers in prominent positions in the store, run end-of-aisle promotions with visible signage, and place healthier, sustainable produce closer to eye level and within easy reach (e.g., at cash registers). Community markets could implement better zoning rules so that consumers know where healthy, sustainable produce is situated and can find it more easily (Cheung et al. 2021). Improving fresh produce displays and providing a more diverse range of healthy, sustainable options—particularly those grown by local farmers—may also boost appeal to Chinese consumers.

Example placement interventions

(Please refer to Appendix B to cross-reference intervention codes to Attwood et al. 2020)

- **PLC1:** Making displays of healthy, sustainable options (buffets, shelves, food carts, food stalls, online shopping platforms, etc.) more engaging
- **PLC2:** Placing healthy, sustainable options in more visible positions in a food display or online screen
- **PLC3:** Increasing the amount of a display or online screen that is dedicated to healthy, sustainable options
- **PLC4:** Providing prepackaged, preplated healthy, sustainable options that are ready to go, making these the most convenient choice for consumers
- **PLC5:** Adding leafy greens or fresh, attractive produce to healthy, sustainable food displays or online screens to prime consumers to select options that contain more fruit and vegetables
- **PLC6:** Introducing a dedicated section for healthy, sustainable options in a food display in self-service restaurants or in retail

CHAPTER 4

Summary and recommendations

This report overviews present and projected food intake patterns in China, concluding that current intake falls short of 2022 CDG. In this section, we highlight the five areas of greatest opportunity to accelerate progress toward adherence to the Chinese Dietary Guidelines.

SUMMARY OF KEY FINDINGS

This report has provided an overview of present and projected food intake patterns in China, concluding that current intake falls short of recommendations laid out in the 2022 CDGs. Based on data from the China Health and Nutrition Survey, the Chinese population is currently overconsuming livestock and poultry meat and cereals compared to the 2022 CDGs, and underconsuming aquatic products, eggs, dairy, fresh fruit, and legumes and nuts. There is thus a clear and pressing need for further research and implementation work to understand how to encourage adherence to the CDGs, yielding a triple win of improving individual and planetary health and strengthening food security.

In this report, we outlined a "6P" framework, summarizing a comprehensive range of behavior change interventions to support the Chinese population toward food choices that align to the CDGs. This includes interventions that target the people preparing food (People), the food offering itself (Product), government-led initiatives (Policy), marketing of healthy and sustainable food choices (Promotion), interventions that improve how healthy and sustainable options are described to consumers (Presentation), and different ways to position healthy and sustainable foods to enhance their selection (Placement). We have endeavored to highlight a full range of factors to consider when implementing "6P" behavior change interventions in China, based on an understanding of regional food intake patterns, preferences, norms, and perceptions derived from our expert interviews and peer-reviewed research.

FUTURE OPPORTUNITIES

Below, we summarize the major takeaways from Section 3, highlighting areas of greatest opportunity to accelerate progress toward adherence to the Chinese Dietary Guidelines, and noting some of the major stakeholders to engage in each effort.

1. **Further incorporating sustainability considerations into the CDGs**

The fact that the 2022 CDGs have started to consider environmental factors should be explicitly highlighted and communicated to the Chinese public, with further efforts made to integrate sustainability into future iterations of dietary recommendations. Recognizing the divergence between current and recommended dairy intake in China, we suggest diversifying the existing dairy guideline to highlight additional ways to meet nutritional needs through a broader range of products.

In addition, we recommend that differentiated dietary guidelines relevant to different regions and population segments in China be developed. Unique and tailored dietary recommendations are needed for populations with very different baseline eating habits and lifestyles; for example, those from urban versus rural areas and those living in different Chinese regions, falling in different income brackets, and representing different age groups (with greater granularity across adult age ranges than in the current segmented guidance).

We envisage that integrating environmental considerations into the CDGs will play a pivotal role in encouraging dietary change in China by enhancing population awareness of the role that personal food choices can play in protecting the environment, as well as in promoting health. This guidance may also improve the perceived acceptability of introducing behavior change approaches to encourage adherence to the CDGs, such as encouraging more diversified protein intake or introducing environmental footprint–labeling initiatives in China.

Key stakeholders to engage here include representatives from the Chinese Nutrition Society, who are responsible for publishing the updated guidelines, the Chinese Center for Disease Control and Prevention, and medical professionals, including nutritionists and dieticians, who can help to promote these to citizens.

2. **Conducting more research on statistical methodology, dietary patterns, and behavior change in China**

We recommend a more comprehensive and data-driven understanding of Chinese consumer food intake and purchasing habits, in line with guidance already laid out in the Outline of Food and Nutrition Development in China (2014–20). This understanding will form the basis of subsequent efforts to promote adherence to the CDGs by providing clear insight into which foods are consumed in

excess, when, where, and by whom, and would yield a more comprehensive understanding of the factors driving this behavior. This information can be used to design more effective and tailored behavior change interventions for different population groups, as well as tracking dietary changes over time in response to their implementation.

Key stakeholders to engage include the National Institute for Nutrition and Health, which is part of the Chinese Center for Disease Control and Prevention within the National Health Commission, in addition to academic research departments that specialize in population health and nutrition. Moreover, developing partnerships with leading food businesses in China would enable more comprehensive data capture on regional eating habits, in line with Opportunity 3 below.

3. **Maximizing the potential of behavioral science to promote dietary change**

We recognize the need for more behavior change research in China, with multidisciplinary partnerships between academia, the third sector, and the food service and retail industries. It would be valuable to develop collaborations between behavioral science, marketing experts, researchers, and practitioners with intimate knowledge of Chinese food culture, norms, and practices. This could involve research into potential challenges and opportunities in the adoption of novel proteins in China, in line with Opportunity 5 below.

Those wishing to encourage behavior change for healthier, more sustainable food choices in China could also benefit from reviewing lessons learned by international research and practice communities. By drawing on existing findings on what works to encourage change, errors made in other locations can be avoided, while progress toward greater adherence to the CDGs in China can be accelerated through adoption of proven best practices.

Stakeholders include international governments, charities, and research organizations, as well as foreign academic institutes that have already researched behavior change approaches, working in collaboration with stakeholders in China who are positioned to implement interventions in real-world settings. This includes food businesses, third-sector organizations and food advocacy groups, community networks, and policymakers working to promote better health and sustainability in the country.

4. **Leveraging online food retail and e-commerce platforms to scale behavior change efforts**

Given the sheer size of the Chinese online food shopping and delivery market, significant positive impacts on health and the environment are likely if behavior change interventions can be successfully delivered and scaled for these mediums. We recommend further research to identify behavior change approaches that would work well across different online platforms in China, in addition to testing options already listed in the Presentation, Promotion, and Placement subsections of this report.

Online food businesses could provide valuable insight into current eating preferences and behaviors, given that these entities hold electronic records of all foods purchased over time by their user base. In partnership with academic and other research stakeholders, these data could yield valuable insights into consumption habits, which could inform development of more effective, tailored behavior change interventions for different subsets of online platform users across diverse regions of China.

5. **New research on alternative proteins**

Novel proteins are a potentially important technology for China, although one that requires further research to fully understand all its implications. This fact was recognized by the Chinese government in 2022, with dedicated innovation funding of $3.1 million targeted at development of alt proteins (Buxton 2022). Further exploration of alt protein technology could support China toward its goals of establishing greater food security and reducing the environmental footprint of food.

Key stakeholders to engage here include research organizations and academics to address current knowledge gaps and explore the potential health, economic, and environmental implications of these products in greater depth. Policymakers could also be offered recommendations on how to scale domestic alternative protein manufacturing capacity in China so that this sector becomes a significant source of locally produced, nutritious, and sustainable protein for the country's population and its export markets.

Appendices

APPENDIX A. FULL METHODOLOGY

The content of this report was based on inputs from three main sources:

1. Original analysis of data on dietary intake and guidelines in China
2. A detailed stakeholder mapping exercise and series of interviews with identified experts in food and sustainability, both in China and internationally
3. A scoping review of Chinese- and English-language literature published on the topics of diet and behavior change in China

Below, we summarize the methods used to analyze data and content from each of these sources.

Source 1: Original data analysis

In this report, the 2022 CDGs mainly reference results of the China Health and Nutrition Survey (CHNS), which are used as the key criteria for evaluating food intake patterns in China (CNS 2022). We have therefore chosen to present CHNS data as our primary dietary data source.

The CHNS data—"Food intake of Chinese residents (2015–17)"—only include at-home intake (NHC 2022). We therefore adjusted these data for food eaten away from home. In this report's Figure 1, this is shown by the addition of upper and lower error bars. Upper error bars reflect an upward adjusted estimate of intake that also incorporates food eaten away from home. This has been calculated by dividing the amount of food bought outside the home by the total amount of food eaten by the population (see Table A1 for details of the calculation and Table A2 for estimates). Lower error bars represent the unadjusted data direct from the CHNS survey. Column height thus represents the average between these two estimates.

With known out-of-home consumption ratios of urban and rural populations, the out-of-home consumption ratio nation wide can then be calculated using the following formula:

$$nr_i = ur_i * w_u + rr_i * w_c$$

nr_i, National out-of-home food consumption ratio of food type *i*,

ur_i, Urban out-of-home food consumption ratio of food type *i*,

rr_i, Rural out-of-home food consumption ratio of food type *i*,

w_u, weight: the share of urban populations in 2016,

w_c, weight: the share of rural populations in 2016.

Table A1 illustrates ur_i and rr_i. W_u and W_c are 58.84 percent and 41.16 percent, respectively, from the *China Statistical Yearbook*. With these figures, nr_i can be calculated. The estimated actual food consumption was then derived by the following formula:

$$C_i = H_i/(1- nr_i)$$

C_i, Estimated consumption of food type *i*,

H_i, at-home consumptions of food type *i*, using data from the *China Statistical Yearbook*,

nr_i, National out-of-home food consumption ratio of food type *i*.

TABLE A1 | Reported out-of-home consumption ratio in 2016 for urban and rural China, separately

INDICATOR	OUT-OF-HOME CONSUMPTION RATIO URBAN 2016	OUT-OF-HOME CONSUMPTION RATIO RURAL 2016
Cereals	21.70%	12.90%
Tubers	23.30%	12.10%
Beans	30.40%	27.50%
Fruit	11.60%	7.70%
Vegetable	17.50%	11.10%
Dairy	16.40%	25.40%
Livestock meat		
Pork	24.20%	20.70%
Beef	35.80%	36.40%
Mutton	36.50%	42.30%
Poultry	29.10%	26.40%
Eggs	17.10%	12.00%
Aquatic products	26.10%	25.70%
Nuts	8.30%	15.60%

Source: AGFEP (2021).

Table A2 shows the results of estimated food consumption (both at-home and out-of-home) in 2015–17.

TABLE A2 | Estimated food consumption in 2015–17

INDICATOR	NATIONAL OUT-OF-HOME FOOD CONSUMPTION RATIO	CDC (2015-17) (AT-HOME) (grams per capita per day)	ESTIMATED ACTUAL FOOD CONSUMPTION WITH OUT-OF-HOME CONSUMPTION (grams per capita per day)
Cereals	18.1%	316.3	386
Tubers	18.7%	41.9	52
Beans	29.2%	10.3	15
Fruit	10.0%	38.1	42
Vegetable	14.9%	265.9	312
Dairy	20.1%	25.9	32
Livestock meat	32.6%	72	107
Poultry	28.0%	13	18
Eggs	15.0%	23.4	28
Aquatic products	25.9%	24.3	33
Nuts	11.3%	3.6	4

Sources: AGFEP (2021); NHC (2022); and author analysis.

Source 2: Stakeholder interviews and workshops

Between December 2021 and March 2022, we conducted a series of semistructured research interviews with food and behavior change experts based in China and internationally.

Experts included authors of key research identified during the scoping reviews, existing contacts from WRI's China office and WRI's food program, and people recommended by other interviewees (i.e., snowball recruitment). Our goal was to listen to a broad range of perspectives on the topic of diet and behavior change in China, including views from government representatives, academics, industry stakeholders, and representatives from third-sector organizations.

In total, we spoke to 40 individuals. Interviews lasted between 30 minutes and one hour. All interviewees were free to abstain from answering any questions, were recorded, providing their verbal consent to participate in the interview, and were given the opportunity to review the report prior to publication. We have kept all content anonymized and do not attribute any direct quotes to interviewees. In addition to the interviews, we ran three workshops with Chinese experts across government, academia, business associations and NGOs to sense check our findings and gain further input. The workshops took place in March 2022, June 2002 and November 2022 with between 15 and 40 participants attending each workshop.

Source 3: Scoping literature review

In addition to the original content informing this report, from data analyses and stakeholder interviews, we also conducted two systemic scoping reviews of relevant English- and Chinese-language academic literature. The goal of these reviews was to understand and incorporate research already published on the topic of dietary behavior change in China, with a focus on promotion of healthy, sustainable diets.

To locate relevant literature, we first determined our key words to input into database search strings in both Chinese and English. These are outlined in Tables A3 and A4 and cover our major focus areas for the report.

TABLE A3 | Key words to identify relevant literature from English-language databases

DIET	SUSTAINABLE/PROENVIRONMENT	MEAT	BEHAVIOR CHANGE	CHINA
Diet Dietary Dietary adjustment Recommended diet Dietary pattern	Sustainability Sustainable Environmental Environmentally friendly Eco-conscious Proenvironmental behavior	Meat Meat consumption Beef consumption Lamb Ruminant meat Plant-based Vegetarianism Vegan	Behavior change Intervention Experiment Theory of Planned Behavior	China Chinese

TABLE A4 | Key words to identify relevant literature from Chinese-language databases

膳食结构	营养变迁	中国	环境可持续	行为改变
食物消费 + 食品消费 + 膳食 + 饮食结构 + 食物结构 + 口粮消费 + 粮食消费 + 动物性食物 + 植物性食物 + 肉类 + 牛肉 + 猪肉	'营养' + 营养变迁 + 营养发展 + 趋势 + 预测	'中国' + 城乡居民 + 城市 + 农村	绿色消费 + 可持续 + 生态文明 + 低碳 + 环境友好 + 环境意识 + 环保	行为 + 行为改变 + 行为科学 + 行为决策 + 行为经济学 + 干预 + 助推 + 食物政策 + 健康教育 + 营养教育 + 公共健康 + 计划行为理论 + 跨理论模型 + 主观规范 + 态度 + 意向 + 意愿 + 沟通

Key words were subsequently formatted into search strings appropriate for each database searched (for examples, see Box A1). The databases included Web of Science, PubMed, Cochrane, Prospero, ProQuest, Google Scholar Alert, Science Direct, Chinese Health and Nutrition Survey Database, Lexus Nexus, EBSCO, EBSCO 2, EBSCO 3, Harvard HOLLIS Library, EBSCO Academic Complete + Environment, Collaboration for Environmental Evidence, Campell Collaboration, EPPI-Centre Systematic Reviews, PROSPERO-NHI, Trials Register of Promoting Health Interventions (TRoPHI), Meat and Livestock Australia, *Science Magazine*, *Nature Sustainability*, NexusUni, EBSCO Discovery, and CNKI.

Following identification of all potentially relevant literature, an initial screen for eligibility was conducted. This involved abstracts from academic publications and the full text of media articles being screened in Rayyan (https://www.rayyan.ai/) using the inclusion and exclusion criteria outlined in Table A5 for Chinese- and English-language resources.

Figure A1 diagrams how the full list of publications were excluded and retained at each stage in the screening process for the English-language search. Following full screening, a total of 555 English-language and 155 Chinese-language publications were eligible for inclusion and used to inform the content of the report.

BOX A1 | Example database search strings

English-language PubMed search

(diet OR dietary OR "dietary adjustment" OR "recommended diet" OR "dietary pattern") AND (sustainability OR sustainable OR environmental OR "environmentally friendly" OR "eco-conscious" OR "proenvironmental behavior") AND (meat consumption OR beef consumption OR lamb consumption OR "ruminant meat" OR "plant-based" OR vegetarian OR vegan) AND ("behavior change" OR intervention OR experiment OR "theory of planned behavior") AND (China OR Chinese)

Chinese-language CNKI database (limited to publications after 2000):

*(*主题 *= S1) AND (*篇关摘 *= S2) AND (*关键词 *= S3) NOT [*关键词 *= (*儿童 + 幼儿 + 学生 + 孕妇 + 妇幼 + 老年 + 糖尿病 + 代谢 + 高血压 + 慢性病 + 心血管 + 饮食文化 + 水足迹 + 氮足迹*)],*

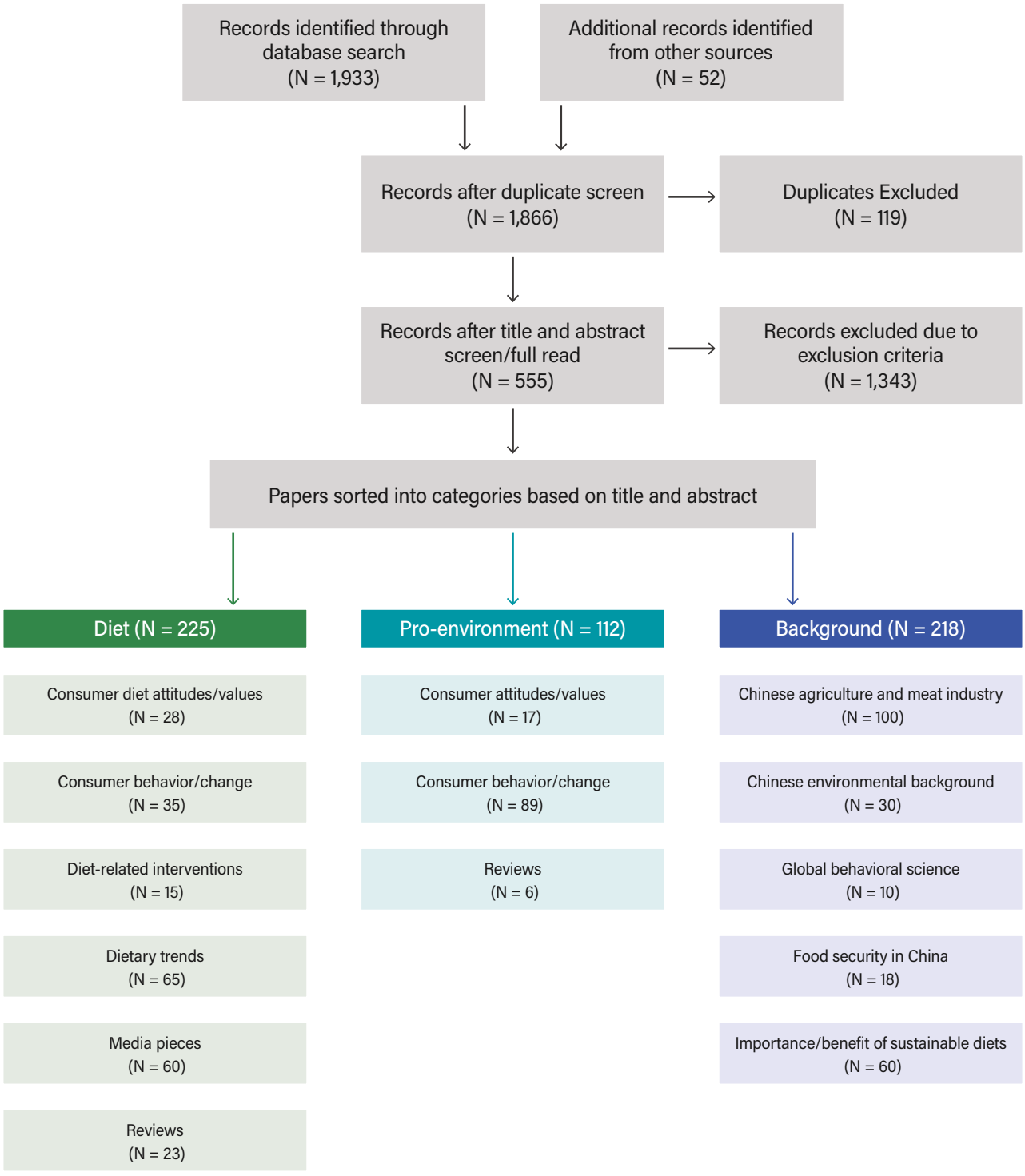
TABLE A5 | Inclusion and exclusion criteria to determine publication eligibility

ELIGIBILITY CRITERIA	INCLUSION	EXCLUSION
English-Language Articles		
Study setting	China	Any country other than China
Topic	Dietary trends and food group consumption Industry reports on meat imports/exports Dietary interventions Food-related purchasing behaviors/attitudes Attitudes/perceptions of vegetarianism, veganism, meat, plant-based foods in China Proenvironmental behaviors/attitudes Interventions promoting nondietary proenvironmental behaviors	Health impacts/chronic disease outcomes associated with specific food groups or nutrient intake Nutrition studies on meat, vegetarianism, veganism Physiology of meat digestion or physiological impacts of meat consumption Impact of climate change on health
Study population	Chinese people (adults and/or children)	Non-Chinese
Study design	Any/all	N/A
Date published	After 2000, quarterly business reports after 2018	Pre-2000
Other	Published in English language	

TABLE A5 | Inclusion and exclusion criteria to determine publication eligibility (Cont.)

ELIGIBILITY CRITERIA	INCLUSION	EXCLUSION
Chinese-Language Articles		
Study setting	China	Any country other than China
Topic	Dietary pattern changes in organic food, green food, meat and poultry, dairy, vegetables, and fruit Willingness to pay/consume, purchasing behaviors, drivers of food environment Green, sustainable, proenvironmental, low-carbon food consumption, carbon emissions of food groups Interventions promoting dietary behaviors for nutritional benefits, interventions of nondietary proenvironmental behaviors Nutrition transition, public health policies Low-carbon, ecological footprints	Food safety, food loss and waste Organizational behaviors Food-water-carbon nexus, climate adaption, pollution, land and soil, biodiversity, food supply chains Interventions for disease control and body weight management Health impacts or chronic diseases outcomes related to diets Water and nitrogen footprints
Study population	Chinese people (adults and/or children)	Non-Chinese or patients with chronic diseases
Study design	Any/all	N/A
Date published	After January 1, 2000	Pre-2000
Other	Published in Chinese language	

FIGURE A1 | Flow diagram detailing the literature exclusion process and final classification of sources



Source: Authors.

APPENDIX B. LIST OF 57 INTERVENTION CODES FROM WRI'S FOOD SERVICE PLAYBOOK

TABLE B1 | The Full List of 57 Behavior Change Interventions to Shift Diners toward More Plant-Rich Options in Food Service Settings

► = above the median value on both feasibility and impact criteria, forming the priority shortlist outlined in Figure 3. Cross-reference Table 1 and Figure 3 using the codes listed below.

	INTERVENTION	CROSS-REFERENCE CODE TO FIGURE 3	MEAN IMPACT SCORE* (1 TO 7 SCALE)	MEAN FEASIBILITY SCORE** (1 TO 7 SCALE)
	PRODUCT			
►	**Reduce the amount of meat in a dish while increasing the amount of plants**	PRD1	6.25	5.94
►	**Improve the flavor and texture of plant-rich dishes**	PRD2	6.19	5.95
►	**Introduce one plant-rich day per week, when all dishes served are plant-rich only**	PRD3	5.67	5.85
►	**Improve the appearance of plant-rich dishes**	PRD4	5.73	5.77
►	**Increase the variety of plant-rich dishes on offer**	PRD5	5.88	5.53
►	**Increase the relative number of plant-rich dishes on offer compared to meat-based dishes**	PRD6	5.63	5.26
►	**Introduce plant-rich alternatives to popular meat-based dishes**	PRD7	5.38	5.42
	Develop new, or improve existing, accompaniments to plant-rich dishes	PRD8	5.14	4.75
	Reduce the portion size of a dish that is served to diners	PRD9	4.50	4.79
	Reduce the size of plate that a dish is served on	PRD10	4.50	4.69
	Blend plants into ground or minced meat-based dishes	PRD11	4.27	4.73
	Add decorations to plant-rich dishes to signal to other diners that these have been chosen	PRD12	3.47	4.13
	Introduce specially designed utensils or packaging for eating plant-rich dishes	PRD13	3.67	3.27
	PLACEMENT			
►	**Make self-service plant-rich food displays (e.g., buffets, shelves, food carts, or stations) more engaging**	PLC1	5.39	5.35
	Place plant-rich dishes in a more visible position in a self-service display (e.g., buffets, shelves, food carts, or stations)	PLC2	4.80	5.55
►	**Increase the amount of a self-service display (e.g., buffets, shelves, food carts, or stations) that is dedicated to plant-rich dishes**	PLC3	5.06	5.12
	Provide preplated or prepackaged plant-rich dishes to make these the more convenient choice for self-service	PLC4	4.86	4.64
	Add green leafy plants or fresh fruit and vegetable displays to the dining environment	PLC5	4.44	4.89
	Introduce a plant-rich-only food section within a self-service display (e.g., buffets, shelves, food carts, or stations)	PLC6	4.17	4.50

TABLE B1 | The Full List of 57 Behavior Change Interventions to Shift Diners toward More Plant-Rich Options in Food Service Settings (Cont.)

► = above the median value on both feasibility and impact criteria, forming the priority shortlist outlined in Figure 3. Cross-reference Table 1 and Figure 3 using the codes listed below.

	INTERVENTION	CROSS-REFERENCE CODE TO FIGURE 3	MEAN IMPACT SCORE* (1 TO 7 SCALE)	MEAN FEASIBILITY SCORE** (1 TO 7 SCALE)
	PRESENTATION			
►	**Use language on menus to emphasize the positive attributes of plant-rich dishes**	PRS1	6.31	6.00
►	**List plant-rich dishes in the main body of a menu, not in a separate "vegetarian" box or "specials" section**	PRS2	5.81	6.19
►	**Use language on menus to recommend plant-rich dishes**	PRS3	5.69	5.94
►	**Remove unappealing language from menus**	PRS4	5.56	5.81
	List plant-rich dishes first on menus	PRS5	4.46	5.21
	Use language on menus to inform diners that plant-rich dishes are the most popular choice	PRS6	4.67	4.67
	Color-code dishes listed on menus (e.g., red, yellow, green) to help diners recognize that plant-rich dishes are the "better" choice	PRS7	4.33	4.25
	Add carbon footprint labels to menus, food labels, or shelf displays	PRS8	4.42	4.08
	Use language on menus to highlight the downsides of choosing meat	PRS9	3.25	4.20
	Add natural images on menus to prompt diners to choose plant-rich dishes	PRS10	3.47	3.43
	Offer only plant-rich dishes on main menus, with meat-based dishes on request from a server or via separate menus	PRS11	3.53	3.33
	PROMOTION			
►	**Offer diners free samples or taste-testing events for plant-rich dishes**	PRM1	5.28	5.44
►	**Publicize the environmental benefits of plant-rich dishes using marketing materials like posters, leaflets, or TV screens**	PRM2	5.20	5.17
►	**Run cross-product promotions on plant-rich dishes and selected drinks, side dishes, or desserts**	PRM3	5.22	5.11
	Publicize the growing popularity of plant-rich options among other diners using marketing materials like posters, leaflets, or TV screens	PRM4	4.82	5.24
►	**Allow diners to add meat to a plant-rich dish for a surcharge**	PRM5	4.96	4.83
	Help diners role model choosing plant-rich dishes in front of their colleagues, friends, or family	PRM6	4.82	4.94
	Provide on-site plant-rich cooking demonstrations or food preparation workshops for diners	PRM7	5.20	4.53
	Run multibuy or buy-one-get-one-free offers on plant-rich dishes	PRM8	4.64	5.00
	Help diners set plant-rich diet goals and monitor their progress over time using a diet diary or app	PRM9	4.86	4.71
	Encourage diners to participate in plant-rich eating challenges	PRM10	4.65	4.80

TABLE B1 | The Full List of 57 Behavior Change Interventions to Shift Diners toward More Plant-Rich Options in Food Service Settings (Cont.)

► = above the median value on both feasibility and impact criteria, forming the priority shortlist outlined in Figure 3. Cross-reference Table 1 and Figure 3 using the codes listed below.

	INTERVENTION	CROSS-REFERENCE CODE TO FIGURE 3	MEAN IMPACT SCORE* (1 TO 7 SCALE)	MEAN FEASIBILITY SCORE** (1 TO 7 SCALE)
	Offer diners additional benefits, rewards, or gifts when diners purchase plant-rich dishes	PRM11	4.83	4.59
	Provide diners with recommendations on how to substitute plant-rich dishes for meat using marketing materials like posters, leaflets, or TV screens	PRM12	4.81	4.52
	Publicize the taste and flavor of plant-rich dishes using marketing materials like posters, leaflets, or TV screens	PRM13	4.07	4.71
	Sell plant-rich dishes at a lower price than meat dishes	PRM14	4.45	4.32
	Coordinate plant-rich dish promotions to tie in with relevant national campaigns	PRM15	4.76	3.76
	Give diners coupons or loyalty card points to redeem on plant-rich dishes	PRM16	4.21	4.16
	Publicize the health benefits of plant-rich dishes using marketing materials like posters, leaflets, or TV screens	PRM17	3.50	4.75
	Use attractive role-models to publicize plant-rich dishes (including celebrities), using marketing materials like posters, leaflets, or TV screens	PRM18	4.21	3.50
	PEOPLE			
►	**Provide chefs and food preparation staff with information about the health and environmental benefits of plant-rich dishes**	PPL1	5.63	5.75
►	**Train chefs and food preparation staff in how to cook and prepare plant-rich dishes**	PPL2	5.55	5.32
►	**Encourage front-of-house staff (e.g., waiters, hosts) to try plant-rich dishes themselves**	PPL3	5.50	5.15
►	**Give chefs and food preparation staff access to the right tools, equipment, and ingredients to prepare plant-rich dishes**	PPL4	5.56	4.83
►	**Reward chefs and food preparation staff who create popular plant-rich dishes**	PPL5	4.91	5.26
►	**Provide front-of-house staff (e.g., waiters, hosts) with talking points to promote plant-rich dishes to diners**	PPL6	5.00	4.85
	Create a peer-network for chefs, potentially by using social media, to encourage sharing of plant-rich dish ideas and recipes and to receive support and feedback	PPL7	4.85	4.46
	Train front-of-house staff (e.g., waiters, hosts) to praise and encourage customers who select plant-rich dishes	PPL8	4.85	4.29
	Offer front-of-house staff (e.g., waiters, hosts) financial, material, or social incentives to sell more plant-rich dishes	PPL9	4.58	3.72

Notes: *Median sample score was 4.85 for impact; **Median sample score was 4.83 for feasibility.

Source: Authors.

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We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

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