



A truck full of produce at a fruit market in Huai'an, China. Consumer demand for horticultural products is growing, prompting the government to invest in agricultural production technology and marketing. (Gwendolyn Stansbury/IFPRI)

19

China's Road to a Nutrition-driven Agricultural and Food System

Kevin Chen* and Zimei Wang

International Food Policy Research Institute (IFPRI), Beijing, China

* Corresponding author: k.chen@cgiar.org

Introduction

During the past four decades, China has experienced market reforms that have transformed it from a centrally planned to a market-based economy, followed by rapid economic and social development. With the national economy growing at an exceptional annual growth rate of above 9% for three decades in succession, China has become the world's second largest economy and an upper-middle-income country (World Bank, 2018). Economic growth, accompanied by increasing agricultural productivity, raised 726 million people out of poverty between 1978 and 2016, with a concurrent decrease in the number of people considered food-insecure of 155 million since 1990 (de Brauw and Suryanarayana, 2015). Although the country has been able to supply adequate calories for its large population, it is still home to the second largest group of undernourished people in the world, with vulnerable populations such as women, children, the elderly, and migrants suffering disproportionately. 'Hidden hunger', the shortage of essential micronutrients, also affects millions of Chinese people (Chen *et al.*, 2015).

The extraordinary economic boom in China has gone hand-in-hand with urbanization, a demographic shift promoted by the government. Whereas approximately 80% of the Chinese population lived in rural areas in 1980, 58.5% were urban residents by the end of 2017 (State Council Information Office, 2018). Rapid urbanization has been accompanied by rising incomes and a burgeoning middle class, resulting in a rapid shift in dietary patterns from grain-based diets to more protein-rich (meat and dairy) and diversified (fruits and vegetables) diets (Fan *et al.*, 2014; Chen *et al.*, 2015). Consumers are more and more concerned with the impacts of their diets on their nutrition and health. Region-to-region and urban-rural disparities in food and nutrition security are narrowing but still exist (Chen *et al.*, 2014). While undernutrition remains a problem, there has recently been a significant increase in overweight and obesity rates, resulting from excessive intake of saturated fats, calories, and/or sugar. Chronic diseases highly associated with diets, such as diabetes, have also been on the rise (Chen *et al.*, 2015).

With the above context in mind, this chapter discusses the linkages between agriculture,

food, and nutrition in China. It begins with an overview of existing nutrition governance and policies, followed by a discussion of the major research progress on agriculture and nutrition links in recent years. The chapter then identifies gaps in current agriculture and nutrition policies, and provides policy perspectives on improving the agricultural sector for improving nutrition in China.

Nutrition Policies and Programs

Policy responses to the nutrition and health transition in China can be traced back to the release of the government's first *Food Structure and Development Outline* in 1993, followed by the *Food and Nutrition Development Outline* (2001–2010). Both of these policies served as overarching frameworks for setting national objectives for food consumption and nutrient intake. The latest outline, *Food and Nutrition Development Outline* (2014–2020), reflects an evolving understanding of China's food security and nutrition challenges and promotes diet diversity based on the daily food intake recommended by *Dietary Guidelines for Chinese Residents*. It aims to upgrade the current diet, heavy on starches and meat, to a balanced combination of cereal, meat, vegetables, fruits, milk, and soy (Fig. 19.1). The 2014–2020 Outline also cuts the recommended average daily intake of energy per person from 2600 kilocalories (kcal) in 1990 to 2200–2300 kcal. It is recommended that cereal should comprise 50% of these calories, while fat should represent less than 30%. The proportion of high-quality protein within the suggested daily protein category has increased from 33% in the 1990s to 45%.

China has recently placed public health at the center of the country's development, showing tremendous political will for health and nutrition. *Healthy China 2030*, approved by the Central Party Committee and the State Council in 2016, is the first national medium- to long-term strategic plan within the health sector. The plan calls for nationwide efforts to evaluate the nutritional content of agricultural products and foods and disseminate this information to broad audiences. The plan applies an approach based on nutrition assessment, guidance, and intervention, especially targeting vulnerable populations.

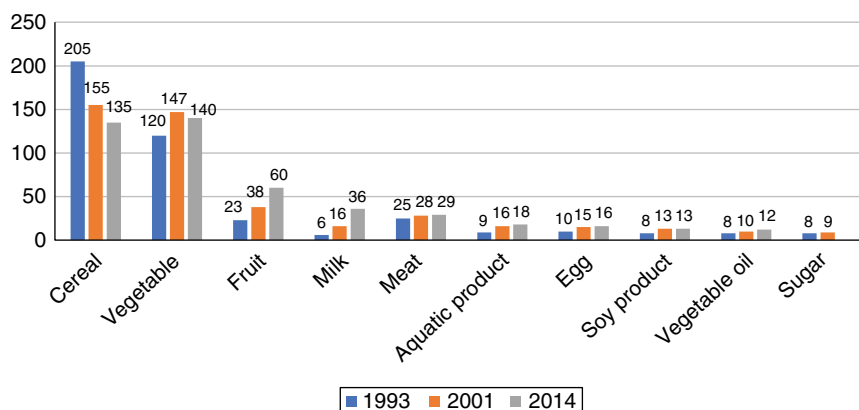


Fig. 19.1. Suggested annual food intake (kg) in three outlines.

In 2017, the *National Nutrition Plan (2017–2030)* was released, incorporating detailed nutritional goals, reasserting the necessity of existing nutrition programs, and proposing new interventions to help populations that suffer disproportionately from undernourishment, stunting, and micronutrient deficiencies (Table 19.1). Though progress has been made, current interventions still focus disproportionately on rural residents, especially infants and children (Xiang *et al.*, 2014), to the neglect of seniors and the urban poor.

The *National Nutrition Plan (2017–2030)* also proposes to promote nutrition research and strengthen monitoring and assessment of people's nutrition status, including intake of iodine, as well as ingredients in food products. It aims to better collect, analyze, and share national nutrition and health data through the current information system. Further efforts will be made to tailor dietary guidelines to the habits of different target groups and regions, following the *Dietary Guidelines for Chinese Residents* released in 2016, mentioned above.

The Chinese government is also beginning to pay attention to the importance of linking agriculture and nutrition through policy actions that could support a nutrition-enhancing food system. The *Food and Nutrition Development Outline (2014–2020)* mentioned above lays out the guiding strategy for working towards equal emphasis on food quantity and quality, coordination of production and consumption, and innovation. Measures will be taken to guide rational and nutritious food consumption, as well as foster a

nutritional needs-driven food industry while conserving the distinctive features of local, traditional diets. The *National Nutrition Plan (2017–2030)* stresses the importance of producing nutritious and safe agricultural products, especially organic and pollution-free ones. It aims for green products and those indicating their geographic origin to account for over 80% of all agricultural products by 2030 (in 2014, they accounted for 40%). National-level demonstrative programs dedicated to research on nutritious staples, and vegetable and animal proteins, will lead the innovation on the production side. Research on minimizing nutrient losses during food processing, storage, and transportation is also championed.

Agricultural and food policies are also evolving to improve the country's nutrition outcomes, albeit with slow progress. China's *No.1 Central Document* is a significant policy document that outlines goals for the upcoming year, traditionally focusing on agricultural and rural issues. The latest version of the document aims to strengthen research on biofortification and food fortification technologies, in an effort to develop more nutritious foods. Other relevant agricultural policies, such as the *13th Five Year Plan on National Agricultural Product Quality and Safety Improvement* and the *13th Five Year Plan on Agricultural Technology Development*, also embrace nutrition as an objective of development strategies. They emphasize the evaluation of agricultural products' quality and nutritional attributes, as well as research on the impact of food processing, storage, and transportation on nutrients.

Table 19.1. Nutrition goals and interventions targeting vulnerable populations. Source: National Nutrition Plan (2017–2030); Fang, 2015.

Target population	Goals in <i>National Nutrition Plan (2017–2030)</i>	Existing and proposed national interventions
Infants (0–6 months) and children (under 5 years of age)	<p>Raising breastfeeding rate to over 50% by 2020, and over 60% by 2030</p> <p>Reducing anemia rate among children to under 12% by 2020, and under 10% by 2030</p> <p>Cutting the prevalence of stunting among children to under 7% by 2020, and under 5% by 2030</p>	<p><i>National Nutrition Plan</i> highlights the 1000 days of a child's life, from the beginning of a mother's pregnancy to the child's second birthday. Closely linked interventions will be designed to improve nutrition for pregnant women, support breastfeeding, and enhance the quality of nutritious supplementary foods</p> <p><i>Nutrition Improvement for Children in Poor Areas</i> program was initiated by the National Health and Family Planning Commission (NHFPC) in 2012, to promote soybean-based and micronutrient-fortified Ying Yang Bao, an in-home complementary food supplement, to improve the nutritional status of children</p>
Primary and middle school students	<p>Reducing height difference between urban and rural students</p> <p>Reducing obesity rate among students</p> <p>Cutting the prevalence of stunting among rural students to under 5% by 2020</p>	<p>The Ministry of Education (MoE) and 14 other departments launched the <i>Nutrition Improvement Program for Rural Compulsory Education Students</i> in 2011 in a bid to address malnutrition among rural students by providing subsidized meals. It has so far reached 1590 counties in 29 provinces (State Council of China, 2017)</p> <p>China launched the <i>School Milk Project</i> in 2000 to ensure that students get safe, nutritious, and affordable dairy products in schools through the support of all levels of government. By 2017 the project has covered 20 million students across 31 provinces</p>
Pregnant women	<p>Reducing folic acid deficiency of pregnant women to under 5%</p> <p>Reducing anemia rate among pregnant women to under 15% by 2020, and under 10% by 2030</p>	<p><i>Improving Nutrition, Food Safety and Food Security for China's Most Vulnerable Women and Children</i> (CFSN) was a 3-year (2009–2013) partnership led by the World Health Organization in collaboration with seven other UN agencies, eight Chinese ministries, and over 20 institutions at the central and local levels. Interventions included providing low-cost Ying Yang Bao, raising food safety and nutrition awareness among pregnant and lactating women, and encouraging the national and regional governments to develop intervention plans and policies targeting food safety and nutrition issues for children</p>
Elderly people	Reducing anemia rate among elderly people to under 10% by 2020	Even though it is home to an aging population, China does not have a large-scale nutrition program targeting elderly people. Routine screening and assessment of nutrition status, and dietary guidelines for seniors are stated as a policy direction in the <i>National Nutrition Plan</i>
People in poor areas	Reducing anemia rate among poor people to under 10% by 2020	Health improvement is one of the major channels for poverty alleviation. Nutrition interventions, such as structural adjustment of agriculture and diets, will be incorporated into an anti-poverty strategy for the next stage

However, a guideline on enhancing the nutritional value of agri-food products, to be released as a result of this research, was mentioned only peripherally. Overall, it appears that the major agricultural policy documents still shy away from nutrition issues.

Agriculture–Nutrition Governance

Various sectors are involved in the work of improving nutrition in China. Nutrition has traditionally been the mandate of the former Ministry of Health, which reported directly to the State Council on its management of food quality and safety. In 2013, the Ministry of Health was dissolved and integrated into a new agency, the National Health and Family Planning Commission. Another key technical agency is the Chinese Center for Disease Control and Prevention (China CDC), which oversees the National Institute for Nutrition and Health, responsible for research on strategies and measures for food safety and nutrition. Technical support for nutrition is also offered by the Chinese Nutrition Society, a non-profit academic organization that provides official dietary and nutritional advice. The Society was commissioned by the Ministry of Health/National Health and Family Planning Commission to develop the *Dietary Guidelines for Chinese Residents*. The Ministry of Agriculture oversees all agriculture-related issues.

In 1993, the State Food and Nutrition Consultant Committee (SFNCC) was set up to improve national coordination and planning of agriculture, food, and nutrition. Ex-or current senior officials of the Ministry of Agriculture typically chair the committee. The SFNCC tasks 31 experts from various fields, including agriculture, food, nutrition, health, economy, and trade, with coordinating national nutrition policies and interventions and accelerating improvements to address the underlying causes of malnutrition. The SFNCC's major achievements include developing the *Food and Nutrition Development Outline* and leading several nutrition interventions nationwide, such as the Soybean Action Program in the early 2000s, which met the needs of students for high-quality protein by providing them with soy-based foods.

In 2012, the Ministry of Agriculture launched the Institute of Food and Nutrition Development

as an administrative and research body of SFNCC. The Institute is committed to: (i) carrying out research on food and nutrition strategies; (ii) coordinating food production, consumption, and nutrition; and (iii) improving Chinese citizens' diets. At the end of 2017, two other related structures came into existence: the National Nutrition and Health Steering Committee (as required by the *National Nutrition Plan (2017–2030)*) and the National Working Group on Nutrition Promotion (created to push the plan forward by the National Health and Family Planning Commission, Ministry of Agriculture, and the General Administration of Sport) (Xinhua Net, 2017). Since the National Health and Family Planning Commission has mostly led the establishment of these various new bodies, their interaction with the Ministry of Agriculture-led SFNCC remains to be seen in the long run.

Despite some positive outcomes, the government has run into difficulties in designing multisectoral mechanisms and policies to link agriculture and nutrition. Coordination failures continue to occur. Given that the SFNCC is an advisory body whereas the decision-making power remains in the hands of both the Ministry of Agriculture and the National Health and Family Planning Commission, the SFNCC lacks the authority to facilitate and monitor intersectoral policies and actions. Though the SFNCC is composed of members from various ministries and agencies, the majority of its members are ex-officials and no one is intuitively in charge. The responsibilities of different parties under such coordination are unclear.

Weak vertical coherence among agriculture and nutrition authorities and institutions at the central and provincial levels is another challenge. Most provinces do not have institutions dedicated to nutrition research or policy-making. Improving nutrition does not affect the political career of local leaders, resulting in a disconnect between high-level policies and practices on the ground.

Major Initiatives for Linking Agriculture and Nutrition

Though having long occupied separate silos with little consideration of their impacts on each other within the policy arena, agriculture and

nutrition are in fact tightly wedded. The purpose of agriculture goes beyond growing crops and livestock as raw materials; it also includes the cultivation of well nourished people and the momentum for economic growth. On the reverse side, the costs of agriculture-related nutrient deficiencies are massive, mainly due to loss in human capital and productivity. In China, this cost was estimated to be 362 billion yuan (US\$57.65 billion) in 2002, accounting for 4% of the GDP (Chinese Association for Student Nutrition and Health Promotion, 2008). Since China's agriculture sector is still dominated by approximately 200 million smallholder farmers (National Bureau of Statistics, 2017), agricultural development can lead to higher incomes, which can be used to purchase more food, higher-quality food, and a more diverse diet. Improved agricultural practices, such as increasing the production of vegetables rich in micronutrients, can also have positive impacts on the nutrition status of farmers, as shown by some successful interventions (Chen, 2013; Yang and Jiang, 2013).

A substantial body of literature has emerged around recent agricultural practices in China, yielding insights on how progress in agriculture can translate to improved nutrition status and economic benefits. There are two major ways in which agricultural production can contribute to enhanced nutrition. The first is through production diversity, which enhances access to a diet rich in not only necessary nutrients but also other important components such as fiber (Frison *et al.*, 2011). China has long produced a diverse range of food crops of major global importance, including rice, wheat, soybean, potato, sweet potato, millet, and yam (Kell *et al.*, 2015). However, agrobiodiversity in China is under threat due to land-use changes and the rapid adoption of hybrid varieties of some of the main crop types. Conservation of agrobiodiversity (see Chapter 4) is promoted in the country's *National Biodiversity Strategy and Action Plan*, which has been translated into provincial action plans (Wu *et al.*, 2015).

The unstable market of cereals (rice, wheat, and maize), especially during the 2008 food crisis, prompted Chinese leaders to strategically release the country's stocks of grains, in order to buffer the price shock and protect people from malnutrition (Jensen and Miller, 2008; Yang *et al.*,

2008). This scare and other factors led the country to further diversify into other crops. Potato, for example, has high nutritional value and provides a good supply of high-quality protein. China has significantly scaled up potato production and is aiming to dedicate 6.66 million hectares for potato production by 2020, 30% of which will be varieties that are suitable to produce food staples. The crop is set to become the nation's fourth food staple after rice, wheat, and maize.

The second key route through which agriculture can benefit nutrition is by increasing the production of highly nutritious foods, with an aim of benefiting either the general public or groups with specific nutritional deficiencies. In the case of staple crops, one way to enhance nutritional value is through biofortification whereby micronutrients are bred directly into staple crops through conventional methods or transgenic techniques (see Chapter 5). Since the introduction of biofortification in China in 2004, studies have been conducted by various institutions to explore crops fortified with zinc (Zn), iron (Fe), and folic acid (Jiang and Zhang, 2015; Li and Shou, 2015; Xie *et al.*, 2016). After a decade-long effort by over 100 domestic scientists and international collaborators, the national biofortification program, called HarvestPlus-China, has achieved initial success. Enriched rice, wheat, maize, and sweet potato with bioavailable Fe, Zn, and vitamin A have been developed, and some of these have been approved for field dissemination (Lei, 2014).

Studies indicate the high cost-effectiveness of biofortification programs. With RMB 1 yuan of investment, the biofortified iron-rich wheat project of HarvestPlus-China could gain benefit of RMB 1118–1940 yuan over 30 years. This rate takes into account the low recurrent costs and significant health benefits that are achieved by reducing the disease burden of iron-deficiency anemia by at most 23.6% as measured by disability-adjusted life years (DALYs) (Li and Zhang, 2016). The positive health impacts of biofortified β -carotene-rich sweet potato have also been demonstrated among young beneficiaries, whose vitamin A deficiency was reduced to a 63.3% effective rate, compared with 42.9% in the control group fed with ordinary potato (Zeng *et al.*, 2008).

An alternative to biofortification is agronomic fortification whereby inputs such as fertilizer are used to boost the micronutrient content

of the crops. Cost-effectiveness analyses show that agronomic fortification of rice and wheat via foliar spray is an effective pathway to help populations relying on wheat within their diets to achieve 75–100% of their recommended Zn intake and decrease the health burden of Fe deficiency by 28% (Zhang *et al.*, 2017; Wang *et al.*, 2016).

Food fortification can enhance the micro-nutrient content of staple foods that are subject to some form of processing, as well as prepared foods. The Chinese government has established a regulatory framework, financed research and development (R&D) in the field, and promoted fortified foods. The government's commitment to food fortification is documented in several existing national plans, dating back to the *National Plan of Action for Nutrition* issued in 1997, which includes two provisions on micronutrient fortification. The *Food and Nutrition Development Outline (2014–2020)* calls for the acceleration of food fortification and regulation of nutritional fortification substances as well.

In line with this commitment, several fortification projects have been launched since the 1990s. China has made it mandatory for all edible salt in the country to be iodized according to the national standards from 1995, successfully expanding the household coverage of iodized salt to 95.3% in 2011. Surveillance data suggests that iodine intake of school-aged children (239 µg/l, measured by median urinary iodine concentration), taken as a proxy for the general population, exceeded the global target in 2011 but needs to be brought back into the optimal range (100–199 µg/l) (Sun *et al.*, 2017). Other major staples and condiments, such as rice, wheat flour (Huo *et al.*, 2011; Sun *et al.*, 2008), cooking oil, and soy sauce, also serve as vehicles for micronutrient fortification. Biofortification and food fortification are key strategies for improving nutrition in China, but the diversification of food production away from staple crops, as mentioned above, may be more critical in the long term.

Major Challenges That Need to Be Addressed

Despite increasing efforts from policymakers to link agriculture and nutrition in China,

there are still a number of challenges that must be addressed.

1. Consumer demand for healthy and high-quality foods is still not being met. A recent study indicates that consumers are turning away from unhealthy foods, as evidenced by declining consumption of staple foods and a growing appetite for a diversity of foods of high or superior quality (Zhou *et al.*, 2012). Yet the current food security strategy in China still largely focuses on boosting agricultural outputs to fuel economic growth and feed the entire population. While such efforts have led to tremendous gains in food production, especially in high-yield staple crops, nutrition still receives limited attention.

2. Activities along the agricultural value chain often have negative effects on nutrition. The links between agriculture and nutrition do not stop at the farm gate. Instead, agricultural products are stored, processed, distributed, retailed, and consumed in a range of ways that could affect their nutritional quality. Nutrient loss during processing, storage, distribution, and preparation due to spoilage, adulteration, inappropriate handling or preparation methods that introduce salt, sugar, fat, colors, and additives deserve more attention. The food and beverage processing industry is the largest user of sugar in China, accounting for 77.7% of the total consumption in 2007 (French and Crabbe, 2010).

3. Significant technological gaps still exist between China and other major international producers, particularly within the fields of biotechnology and integrated crop management for nutritious products. The country's innovative capacity for improving nutrition is limited by a lack of human capital, facilities, and financial support, and the adoption rate of advanced and sustainable technologies is low due to high costs and low provision of extension services. Though China's public R&D expenditure on agriculture has been growing quickly in recent years, its agricultural R&D intensity (R&D expenditure as a percentage of GDP) was only 0.63% in 2015, lower than the 1% suggested by FAO (Fan *et al.*, 2017).

4. There are currently no clear linkages between agriculture and nutrition interventions carried out in the country. China still lags behind when it comes to designing agriculture–nutrition interventions with cross-sectoral benefits. Agriculture

interventions lack explicit goals of addressing malnutrition and, likewise, nutrition programs' lack of consideration of upstream agricultural activities often raises concerns over food safety and program sustainability. It is also difficult for local rural economies to benefit from such interventions.

5. There is poor public awareness of nutrition issues. Studies on people's nutrition-related knowledge, attitudes, and practices indicate that, although some possess good attitudes toward nutrition and nutrition education, and show a willingness to improve their dietary behaviors, ordinary Chinese residents lack basic nutrition knowledge, as well as an awareness of nutrition-related diseases (Jia *et al.*, 2010; Guo *et al.*, 2015; Qi *et al.*, 2015). Gaps in public health and nutritional awareness lead to unhealthy food-consumption patterns across all age groups (Zhang and Sun, 2008; Guo *et al.*, 2015).

Policy Options for Linking Agriculture and Nutrition

Although China has benefitted from ongoing agricultural and economic success associated with significant improvement of food security, it remains burdened with nutritional challenges and complex gaps between agricultural production, consumption, and nutrition. A number of researchers have highlighted the fact that the availability and affordability of diverse and nutritious crops necessary for healthy diets has been neglected, and that the agriculture sector should consider how the food it produces translates into good nutrition and better health (Xu *et al.*, 2008; Wan, 2014; Chen *et al.*, 2015).

Looking ahead, there are a number of policy actions that China can take to establish and strengthen the linkages between agriculture and nutrition.

1. The country needs to introduce nutrition laws and regulations. Efforts to promote public health and nutrition status in China through legal mechanisms began in the late 1980s, but have since been held up (Zhai, 2012). As the importance of nutrition security becomes clear, lawmaking has returned to the forefront. For example, the draft *National Nutrition Improvement Act*, expected to be approved soon, will set nutritional targets for

agri-food production, educate nutrition professionals, and ensure the sustainability of relevant policies and programs (Zhang *et al.*, 2011; Xu *et al.*, 2015). A multisectoral approach will also benefit from a sound legal framework which can articulate the government entity in charge of agri-nutrition coordination, as well as its composition, authority, and responsibility. Alongside these efforts, it is also critical to mobilize higher-level support for nutrition. For example, agri-nutrition coordination can take place under the office of president or prime minister, in order to hold participants of equal status accountable for their nutrition efforts (Levinson and Balarajan, 2013).

2. Nutrition-sensitive agricultural value chains should be promoted, as people's reliance on markets for satisfying their food and nutrition needs is bound to increase as urbanization continues (FAO, 2017). These efforts entail leveraging opportunities to enhance supply and/or demand for nutritious foods (such as fruits, vegetables, beans, fish) and identifying entry points to maximize nutritional benefits at every step of the chain, through actions such as biofortification, nutrient-preserving storage and transport, food fortification during processing, and nutrition signaling and labeling (see Chapter 3).

3. Investing more in nutrition-sensitive agricultural R&D is essential to advance the contribution of the agricultural sector to nutrition objectives. More attention should be paid to techniques for improving the nutritional quality, not just quantity, of agricultural products. Potential research areas include nutritious crop breeding, nutrition-enhancing cultivation, and nutrition-maintaining processing. The government can also improve regulations and policies to incentivize the private sector to increase its own investment in agricultural R&D, with options including the protection of intellectual property rights, tax concessions, and secured access to land.

4. Policy and program designers should adopt an integrated approach for inclusive nutrition interventions, particularly for those targeting vulnerable groups, including seniors and the urban poor, who remain in the shadows of large-scale programs focusing on infants and children. International lessons have provided several promising options, such as conditional cash transfer programs (Mohiddin *et al.*, 2012; Chen *et al.*, 2018). Some China-based projects have served as good examples for these types of

interventions. *Improving Nutrition, Food Safety and Food Security for China's Most Vulnerable Women and Children* (CFSN), for example, promoted production diversification by supporting rural households to grow vegetables rich in iron and vitamin A, as well as to raise poultry and livestock, which had positive impacts on the lives of the poor, women, and children in western China (Chen, 2013; UNDP, 2013).

5. Efforts should be made to increase consumers' nutrition literacy for healthier dietary choices. Sound knowledge and understanding of nutrition is instrumental in guiding consumers' food choices towards healthy and nutritious products, which will not only improve individual health, but also open new markets for

agricultural producers and incentivize them to produce high-quality agri-foods.

6. Finally, integrated strategies should be based on evidence. New insights on agri-nutrition links can be fulfilled by a robust food and nutrition monitoring and surveillance system, as proposed by the *Nutrition Improvement Work Management Approach* in 2010. Comprehensive, timely, and regularly collected consumption indicators such as caloric intake and dietary diversity are needed to formulate nutrition-focused agricultural strategies, while outcome indicators such as health and economic status should be tracked to indicate the impact and effectiveness of such strategies (Fan *et al.*, 2014; Chen *et al.*, 2015).

References

- Chen, J. (2013) *Final Evaluation Report of MDG Achievement Fund Joint Programme on Improving Nutrition, Food Safety and Food Security for China's Most Vulnerable Women and Children*. MDG Achievement Fund, New York. Available at: <http://www.mdgfund.org/sites/default/files/China%20-%20Nutrition%20-%20Final%20Evaluation%20Report.pdf> (accessed 19 December 2018).
- Chen, K.Z., Yu, B. and Long, Y. (2014) *Major Challenges and Constraints for Transforming China's Agriculture*. Background paper submitted to the WFP/MOA China Food Security Strategic Review. World Food Programme and Chinese Ministry of Agriculture, Beijing.
- Chen, K.Z., Nie, F., Fang, X. and Bi, J. (2015) *Develop Nutrition-based Food Security Strategy in China*. Report submitted to the China Institute for Rural Studies, Tsinghua University, Beijing.
- Chinese Association for Student Nutrition and Health Promotion (2008) *Chinese Child Nutrition and Health Report 2008*. China Population Publishing House, Beijing.
- de Brauw, A. and Suryanarayana, M.H. (2015) Linkages between poverty, food security and undernutrition: evidence from China and India. *China Agricultural Economic Review* 7(4), 655–667.
- Fan, S., Chen, K.Z., Rhee, T., Nie, F. and Fang, X. (2014) *China's Food and Nutrition Security under Rapid Transformation: Enhanced Strategic Partnership with WFP*. Report submitted to the World Food Programme (WFP)/Chinese Ministry of Agriculture (MOA) China Food Security Strategic Review, Beijing.
- Fan, S., Chen, K.Z., Zhang, Y. and Gao, Y. (2017) *Agriculture R&D System Reform in China and International Lessons*. Report submitted to the Ministry of Agriculture, Beijing.
- Fang, X. (2015) *Review of Nutrition and Health Status and Policy in China*. China Agricultural University, Beijing, China.
- FAO (2017) *Nutrition-sensitive Agriculture and Food Systems in Practice*. Food and Agriculture Organization of the United Nations, Rome. Available at: <http://www.fao.org/3/a-i6983e.pdf> (accessed 1 January 2018).
- French, P. and Crabbe, M. (2010) Mega-wok – China's diet from cabbage to cuisine. In: *Fat China: How Expanding Waistlines are Changing a Nation*. Anthem Press, London, New York, Delhi, pp. 45–82.
- Frison, E.A., Cherfas, J. and Hodgkin, T. (2011) Agricultural biodiversity is essential for a sustainable improvement in food and nutrition security. *Sustainability* 3(1), 238–253.
- Guo, Y., Yang, Y., Wang, X. and Sun, J. (2015) Plight and consideration of residents' cognition to food nutrition in China under new situation. *Food and Nutrition in China* 21 (10), 8–11.
- Huo, J., Sun, J., Huang, J., Li, W., Wang, L. *et al.* (2011) The effectiveness of fortified flour on micronutrient status in rural female adults in China. *Asia Pacific Journal of Clinical Nutrition* 20 (1), 118–124.
- Jensen, R.T. and Miller, N.H. (2008) The impact of food price increases on caloric intake in China. *Agricultural Economics* 39 (1), 465–467.

- Jia, G., Li, L., Liu, B., Sun, G., Zhang, P. *et al.* (2010) Study on the awareness of Chinese dietary guidelines and relative nutritional knowledge among customers in Nanjing. *Modern Preventive Medicine* 37, 4614–4616.
- Jiang, L. and Zhang, C. (2015) Folate fortification in crops. *Chinese Bulletin of Life Sciences* 27(8), 1055–1059.
- Kell, S., Qin, H., Chen, B., Ford-Lloyd, B., Wei, W. *et al.* (2015) China's crop wild relatives: diversity for agriculture and food security. *Agriculture, Ecosystems and Environment* 209, 138–154.
- Lei, X. (2014) *Biofortification in China*. Conference brief #26 of the 2nd Global Conference on Biofortification: Getting Nutritious Foods to People. International Food Policy Research Institute (IFPRI), Washington, DC, pp. 75–76. Available at: http://www.harvestplus.org/sites/default/files/Biofortification_Progress_Briefs_August2014_WEB_0.pdf (accessed 19 December 2018).
- Levinson, F.J. and Balarajan, Y. (2013) *Addressing Malnutrition Multi-sectorally: What Have We Learned from Recent International Experience?* UNICEF Working Paper. UNICEF and MDG Achievement Fund, New York.
- Li, L. and Shou, H. (2015) Iron biofortification of crop plants. *Chinese Bulletin of Life Sciences* 27(8), 1037–1046.
- Li, L. and Zhang, J. (2016) The cost-benefit and cost-effectiveness of HarvestPlus-China Program: an ex-ante analysis of biofortified iron-rich wheat in China. *Current Biotechnology* 6 (6), 414–421.
- Mohiddin, L., Phelps, L. and Walters, T. (2012) *Urban Malnutrition: a Review of Food Security and Nutrition Among the Urban Poor*. Report 8 drafted by NutritionWorks, London. Available at: <http://www.nutritionworks.org.uk/our-publications/programme-review-and-evaluation/2011/153-urban-malnutrition-a-review-of-food-security-and-nutrition-among-the-urban-poor> (accessed 20 December 2018).
- National Bureau of Statistics (2017) *The Third Agricultural Census in China*. Available at: http://www.stats.gov.cn/tjsj/tjgb/nypcgb/qgnypcgb/201712/t20171215_1563539.html (accessed 1 January 2018).
- Qi, J., Liu, F., Cui, D., Du, Z., Liu, Z., Zhang, Z. and Ren, Z. (2015) Investigation on knowledge about food nutrition labeling among consumers in Pinggu District of Beijing. *Occupation and Health* 31, 2640–2647.
- State Council Information Office (2018) Press conference on China's economic performance in 2017. Available at: <http://www.scio.gov.cn/xwfbh/xwfbh/wqfbh/37601/37783/index.htm> (accessed 1 January 2018).
- State Council of China (2017) Nutritional Improvement Program benefits over 36 million Chinese rural students. Available at: http://english.gov.cn/news/top_news/2017/06/03/content_281475675232760.htm (accessed 1 January 2018).
- Sun, D., Codling, K., Chang, S., Zhang, S., Shen, H. *et al.* (2017) Eliminating iodine deficiency in China: achievements, challenges and global implications. *Nutrients* 9(4), 361–383.
- Sun, J., Huo, J., Li, W., Wang, L., Huang, J., Li, Z. and Wan, L. (2008) Study on effectiveness of nutrition intervention of fortified flour on rural women in western China. *Chinese Journal of Food Hygiene* 20 (2), 117–121.
- UNDP (2013) *A UN Success story: Improving Nutrition, Food Safety and Food Security for China's Most Vulnerable Women and Children*. Multi-partner Trust Fund (MPTF) Office of the United Nations Development Programme (UNDP), New York. Available at: mptf.undp.org/document/download/12818 (accessed 1 January 2018).
- Wan, B. (2014) Improve food and nutrition strategy in China. *Farmers Daily*, 21 February.
- Wang, Y., Zou, C., Mirza, Z., Li, H., Zhang, Z. *et al.* (2016) Cost of agronomic biofortification of wheat with zinc in China. *Agronomy for Sustainable Development* 36, 44.
- World Bank (2018) *The World Bank in China*. Available at: <http://www.worldbank.org/en/country/china/overview> (accessed 1 January 2018).
- Wu, J., Yu, Z., Liu, H., Liu, J., Zhao, F. and Xue, D. (2015) Progress in elaborating provincial biodiversity strategy and action plans (BSAP) and strategies for implementation. *China Population, Resources and Environment* S1, 555–557.
- Xiang, Z., Huang, W., Song, T., He, J., Yin, L. and Zhang, Y. (2014) Nutrition improvement measures for vulnerable populations in rural areas of China: a systematic review. *Chinese Journal of Evidence-Based Medicine* 14(11), 1389–1395.
- Xie, B., Gang, J., Han, L., Yang, J. and Cao, L. (2016) Progress in biofortification zinc-enriched food. *Journal of Dalian Minzu University* 18(5), 473–477.
- Xinhua Net (2017) Three ministries and departments will jointly implement the National Nutrition Plan. Available at: http://www.xinhuanet.com/politics/2017-12/22/c_1122155018.htm (accessed 1 January 2018).
- Xu, P., Zhang, F., Hu, X., Zhang, Q. and Ma, G. (2015) Necessity of student nutrition legislation in China. *Food and Nutrition in China* 21(12), 81–84.

- Xu, S., Li, Z. and Li, G. (2008) Develop modern agriculture for health and nutrition. *Food and Nutrition in China* 1, 8–11.
- Yang, L. and Jiang, Z. (2013) Effectiveness of the Sub-project of MDG Achievement Fund Joint Programme on Improving Nutrition, Food Safety and Food Security for China's Most Vulnerable Women and Children implemented in Pan County. *Services of Agricultural Technology* 30 (4), 426–427.
- Yang, J., Qiu, H., Huang, J. and Rozelleb, S. (2008) Fighting global food price rises in the developing world: the response of China and its effect on domestic and world markets. *Agricultural Economics* 39, 453–464.
- Zeng, G., Lin, L., Liu, Z., Yan, L., Sun, C. and Lan, Z. (2008) Study on the nutritional intervention of biofortified beta-carotene rich sweet potato on vitamin A status of children. *Acta Nutrimenta Sinica* 30(6), 575–579.
- Zhai, F. (2012) Advances on nutritional science research in China. In: *China Food Industry Annual Report 2012*. China Light Industry Press, Beijing.
- Zhang, B., Zhai, F. and Zhang, H. (2011) Impact of nutrition legislation on China's nutrition improvement and nutrition education. *China Food Newspaper*, 11 October.
- Zhang, M., Zhao, W., Gao, A., Su, T., Wang, Y. *et al.* (2017) How could agronomic biofortification of rice be an alternative strategy with higher cost-effectiveness for human iron and zinc deficiency in China? *Food and Nutrition Bulletin* 39(2), 246–259. doi: 10.1177/0379572117745661.
- Zhang, X. and Sun, G. (2008) Development study of influencing factors and current situation of nutrition KAP among consumers. *Health Education and Health Promotion* 3, 45–48.
- Zhou, Z., Tian, W., Wang, J., Liu, H. and Cao, L. (2012) *Food Consumption Trends in China*. Report submitted to the Australian Government Department of Agriculture, Fisheries and Forestry, Canberra. Available at: <http://www.agriculture.gov.au/SiteCollectionDocuments/agriculture-food/food/publications/food-consumption-trends-in-china/food-consumption-trends-in-china-v2.pdf> (accessed 19 December 2018).