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No. 09: The State of Household Food Security in Nanjing, China

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HUNGRY CITIES PARTNERSHIP

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Executive Summary

This report should be read in conjunction with HCP Report No. 1: *The Urban Food System of Nanjing, China* (Si et al 2016a). That report provides essential contextual background on the history, demography, and economy of Nanjing. In addition, it contains an overview of the existing literature on Nanjing's changing food system. This report presents and analyzes the findings of a follow-up, city-wide household food security baseline survey conducted by Nanjing University and the Hungry Cities Partnership (HCP) in Nanjing in July 2015. The survey interviewed a total of 1,200 households across Nanjing's 11 districts. The major findings are as follows:

- Most of Nanjing's residents are food secure, with high levels of access to desirable foods and high dietary diversity throughout the year. The average HFIAS (food access) score was 0.61, showing that very few households experience any of the usual symptoms of food insecurity. The average HDDS (dietary diversity) score was 7.8 (out of a possible 12) and the average MAHFP (food availability) score was an extremely high 11.99.
- The low levels of food insecurity among Nanjing residents are related to the city's high level of economic development, low unemployment, and spatially dense food supply networks.
- A high average level of food security obscures the finding that about one household in five is food insecure according to the Household Food Insecurity Access Prevalence (HFIAP) indicator.
- Higher household income was associated with higher dietary diversity, yet the difference among different income groups was small.
- Households with a single household member were the most food insecure compared to households with two or more members.
- Households that had income from a formal wage were much more food secure than households that did not.
- Households practising urban agriculture were slightly more food secure than households that were not.
- The increase in food prices has affected Nanjing residents' choice of food. The food most often not consumed because of its price is meat.
- Cross-validation between HFIAP and the impacts of food price increases reveals that the rise in price had the least impact on food secure households. The group most likely to be affected by food price increases were mildly food insecure households.
- The food type consumed by the most households was grains (steamed buns, rice noodles, biscuits, or any other foods made from millet, sorghum, maize,

rice and wheat). The second most widely consumed food type was vegetables, followed by fruit, meat and meat products (primarily pork), and eggs.

- Fresh or cooked vegetables and fresh fruits are the most commonly purchased food items. Fresh pork is the third, which confirms the dominant position of pork in animal food in China.
- Wet markets are the most widely used food source, followed by supermarkets. The most commonly purchased food items (i.e. vegetables, fruit and pork) were most frequently purchased at wet markets.
- There appears to be more complementarity than competition between wet markets and supermarkets. While wet markets are the top source for purchasing fresh produce and meat, supermarkets are the top source for staple grains, dairy products, and processed food. This suggests that competition between supermarkets and traditional food outlets is less significant than supposed.
- More than four households in five purchased fresh or cooked vegetables at least five days a week.
- Most food items are purchased within neighbourhoods or within walking distance of the home. This indicates that most households have good physical access to food outlets in the city.
- The greater variety of foods and the accurate measurement of food are the two most widely agreed upon reasons that people buy food at supermarkets. There is no consensus as to why people do not buy food in supermarkets.
- About one household in five was engaged in urban agricultural activities. Limited access to land was the major reason that people do not practise urban agriculture. The most common urban agricultural activity in Nanjing is growing vegetables.
- Three in four respondents feel vulnerable and exposed to threats of unsafe food from the production and processing stages of food supply chains, especially from the overuse of agrochemicals in the agriculture and livestock industry. Pork and vegetables are perceived to be the least safe foods.
- There is a high level of consensus that the ineffective enforcement of regulations by local governments is the major cause of food safety problems and thus the government should be the most responsible player to address the problems.

This report provides valuable information for policy as well as future research on Nanjing's food system. One of the key findings is the city's high level of food security compared to other cities in the HCP project. Further studies of the factors that contribute to food security in Nanjing will offer lessons and experience to other cities in achieving urban food security. These include not only socio-economic advancement and opportunity but also local policies that guarantee a sustainable and sufficient food supply. These policies in urban planning and food

system governance might better ensure an operational and reliable infrastructure for food supply.

Despite the high overall levels of food security, female-centred households, households that have no formal-wage worker, and households with only one member tend to be the most food insecure households. In addition, the most food insecure households have a monthly income of less than CNY3,000 (USD483)[1]. Thus, to further enhance the food security of urban households in Nanjing, relevant policies should target these groups.

The fact that wet markets still dominate fresh produce and meat retailing in Nanjing demands continuous policy support for wet markets. The relationship between wet markets and supermarkets is more complementary than competitive. Given that wet markets are visited much more frequently than other food outlets, food governance should prioritize the functioning of wet markets. Alternative food sources other than wet markets and supermarkets, especially restaurants, online food markets and urban agriculture, deserve more policy attention. More research is necessary to examine their roles in maintaining urban food security and achieving other development goals. Given the current developmental goals of the Chinese government to achieve sustainability and support urban agriculture, more attention should be paid to the various challenges facing urban agriculture.

Serious food safety concerns constitute a critical part of the food security calculus of Nanjing residents. It is also vital to investigate the implications of everyday food safety perceptions and practices for food-related policies and governance priorities. The fact that chemical residues in vegetables and meats are considered the most serious food safety problems points to the urgency of shifting to ecological ways of food production, while enforcing standards of quality control more strictly. People are generally unsure about many issues related to food safety and quality, as exemplified by the common confusion over different certification standards. They also demonstrate little awareness of structural problems linked to the increasingly industrialized food system and their own roles in mitigating some of its consequences. This calls for more transparent information sharing schemes and effective food education strategies in policy design to enhance the overall "food literacy" of the general public.

1. Introduction

This report on the state of food security in Nanjing is based on a 2015 city-wide survey conducted by Nanjing University and the Hungry Cities Partnership. The report provides a detailed description and analysis of the findings and consists of seven sections. Section 2 provides a discussion of the sampling strategies used to create a city-wide picture of Nanjing that is as representative as possible. Section 3 profiles the surveyed households included in the sample in terms of demographic characteristics, economic data, livelihoods and occupations, poverty indicators, and the use of social grants. Section 4 discusses the prevalence of food insecurity in Nanjing using three food insecurity indicators: the Household Food Insecure Access Scale (HFIAS), the Household Dietary Diversity Score (HDDS), and the Months of Adequate Household Food Provisioning (MAHFP) indicator. Section 5 explores the factors affecting food security, the impact of food price changes on food accessibility and the relationship between food security and household characteristics. Section 6 examines Nanjing's food system from the point of view of people's usage of various food sources, what foods they buy, and how they perceive supermarkets and urban agriculture. The final section discusses the issue of food safety, which is a major concern of residents of Nanjing.

2. Methodology

The Hungry Cities Partnership survey of Nanjing was completed in July 2015 in partnership with Nanjing University. The city-wide survey was administered by 22 student enumerators from the university over a 10-day period. The students were first trained in the use of tablets for survey implementation. Since the household registration data was not available, the sampling was based on population data from the most recent national census in 2010 to ensure that the city-wide sample was as representative as possible.

HCP/Nanjing University Student Fieldwork Team

Canada-China HCP Research Leaders at Nanjing Wholesale Market

Training Nanjing University Students

Sampled Apartment Building

Interviewer with Household Head

Given that there are four different administrative division levels in Nanjing, including the municipality, district, sub-district and community, the sampling process included five stages. In the first stage, the target number of 1,200 households was distributed among Nanjing's 11 districts based on the population size of each district (only urban populations counted in Lishui and Gaochun districts) using stratified sampling (proportionate allocation). Second, sub-districts that could be defined as urban were selected. The number of sub-districts selected within each district was calculated using stratified sampling (proportionate allocation) based on the total number of sub-districts within each district. In other words, more sub-districts were sampled from districts with more sub-districts and vice-versa. Two or more sub-districts were sampled within each district (except Gaochun and Lishui districts, which only included one urban sub-district each). In total, 29 sub-districts were sampled.

In the third stage of the sampling process, communities (officially defined as residential neighbourhoods or shequ in Mandarin) within each sub-district were selected. Two or more communities were sampled within each of the sampled sub-districts using stratified sampling (proportionate allocation) based on the total number of communities within each sub-district. In other words, more communities were sampled from sub-districts that contain more communities. In total, 100 communities were randomly selected across Nanjing using this method (Table 1). Fourth, households were selected within each community. The sample size of households for each community was determined using stratified sampling (proportionate allocation). For example, if a sub-district was assigned a 200-household sample size, then that sample was distributed among the selected communities within that sub-district using stratified sampling with

proportionate allocation (larger sample sizes were drawn from communities with bigger population sizes and smaller sample sizes from communities with smaller population sizes).

TABLE 1: Number of Sampled Sub-Districts, Communities and Households

District	Population (million)	Sub-district	Communities	Households
Gulou	1.30	4	14	202
Qinhuai	1.03	4	12	160
Xuanwu	0.66	2	5	102
Qixia	0.66	3	12	102
Jianye	0.45	2	8	70
Yuhuatai	0.42	2	4	65
Jiangning	1.18	3	11	183
Liuhe	0.93	4	21	144
Pukou	0.73	3	6	113
Gaochun	0.42 (0.15)*	1	3	23
Lishui	0.42 (0.22)*	1	4	34
Subtotal		29	100	1,198

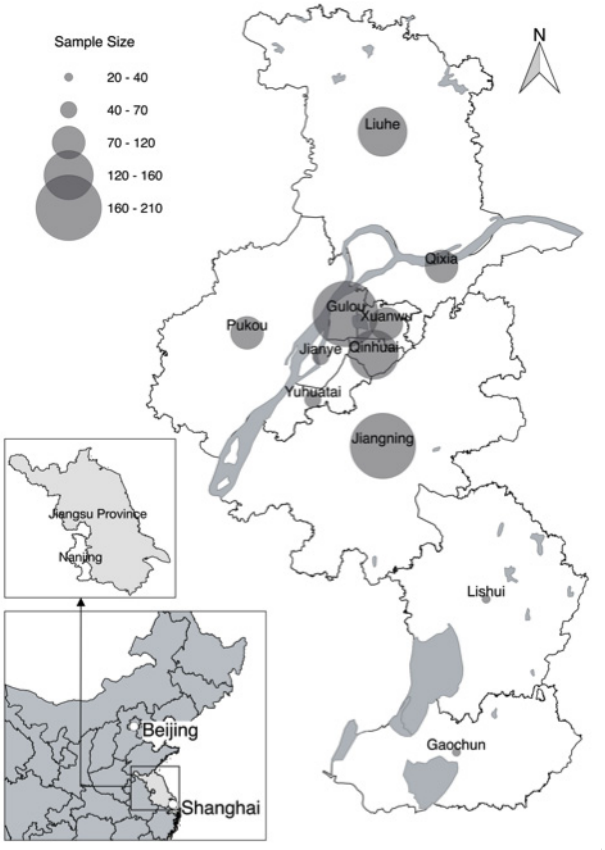
** These two districts have a large rural population outside their town centres. Therefore, we used the town centres' population, as shown in the brackets, for sampling.*

Finally, within each community, enumerators were evenly spaced across each community and used a random number generator to randomly select the buildings they would sample and then the floor that they would sample. This approach was used because most people in Nanjing live in apartment buildings. Once the floor was randomly selected, the enumerators systematically sampled apartments in these buildings (every third apartment). If a household was unable to respond to the survey, the next household was approached. The enumerators were trained to repeat this step until the sample size was reached within each community.

The sampling procedure used in this household survey was thus informed by representative sampling methods and logistical constraints. The 1,200 household sample size was calculated based on the number of feasibly achievable household surveys that could be completed by the enumeration team in the allotted time (maximizing the sample size while maintaining the quality of survey responses), while ensuring a minimum confidence interval of +/- 0.05 19 times out of 20 (assuming simple random sampling). The sampling strategy was designed to ensure an equal distribution of inclusion probabilities for every household in the target population (as much as possible). Without access to a complete registry of households in the city, alternative methods to simple random sampling were used, as described previously. That said, this procedure is susceptible to path-dependence and biased to visibly identifiable dwellings (both of which are defined by the structure of the built environment). Given that the majority of households in Nanjing reside in flats, the random walk procedure was deemed

to be an acceptable parallel to simple random sampling in the majority of urban contexts in the city. In sum, given the methods used and limited comparability with census statistics, it is not possible to claim that the survey is representative beyond a doubt, but there is sufficient evidence to make the argument that the survey is likely representative of households in Nanjing.

FIGURE 1: Distribution of Sampled Households*



** The map was constructed using the survey data in ArcGIS. The size of the circles represents the number of sampled households. The bigger the circle, the more sampled households the district has. Shaded areas represent the major water bodies in Nanjing, including the Yangtze River and lakes.*

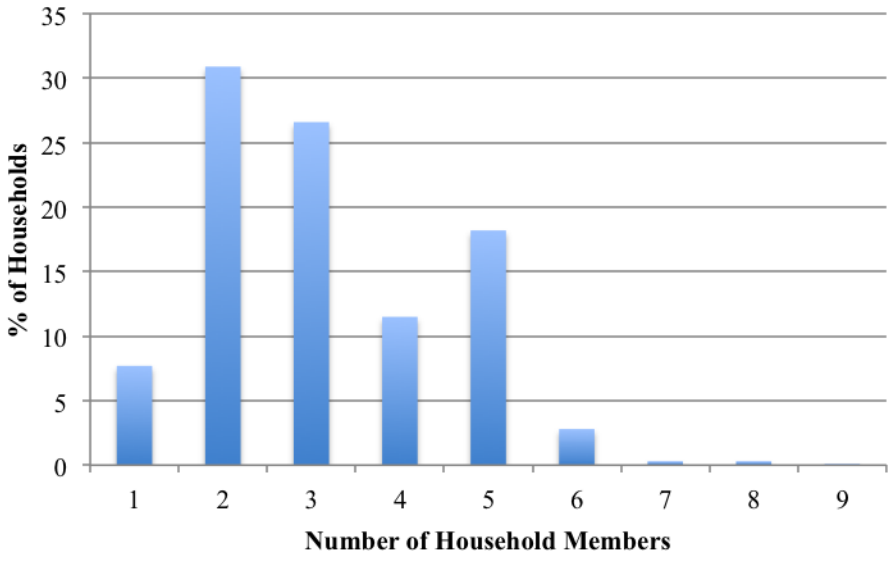
3. Profile of Nanjing Households

The HCP survey instrument contained several questions relating to the characteristics of the households and their members. This data provides a background picture for the sections that follow regarding food security and the food system.

3.1 Demographic Characteristics

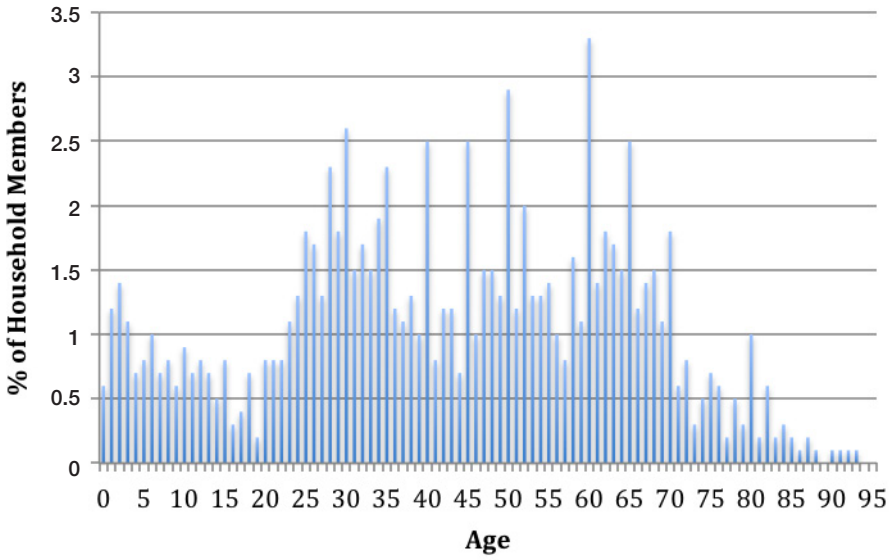
The average household size was 3.13, which was higher than the average family size, 2.77, reported by Nanjing's most recent census conducted in 2010. This difference is probably because of the relatively broad definition of household used by the HCP survey. By a household we mean people "who eat from the same wok" including all who are living together but are not necessarily related to the household head. This means that households can include two or more families as long as they are living and eating together. The most typical situation in Nanjing is that a couple would live with their parents under the same roof. Although they constitute two families in terms of household registration, they are considered as one household in the survey. The frequency distribution of household size shows that 31% of households had two household members, followed by households with three members (27%) and five members (18%) (Figure 2). Households with only one member make up 8% of the surveyed households. There were very few households with more than five members.

FIGURE 2: Distribution of Household Size



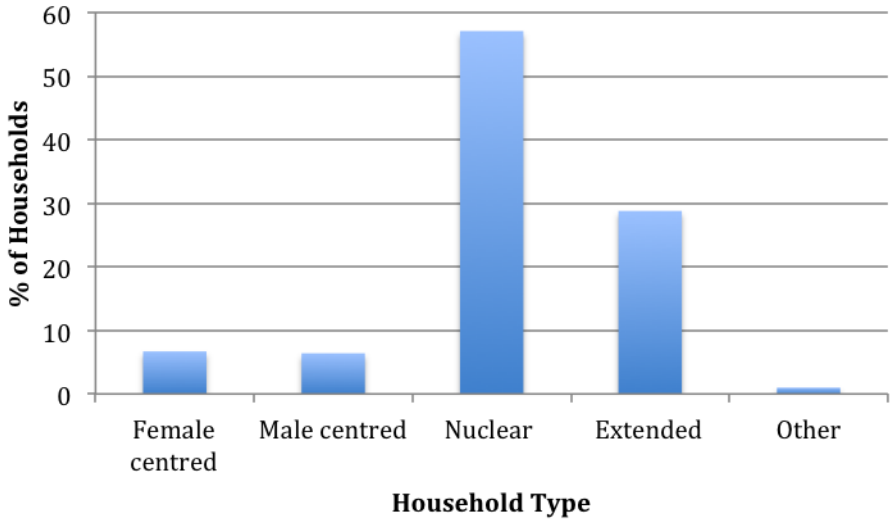
The age distribution of the 3,301 household members with age data shows that most of the population is between the ages of 30 and 60 (Figure 3). About 40% of household members were younger than 35 and 16% were under the age of 20. The number of households with a member of 80 years or older was very limited (2%). The fact that the population is generally young is related to the high percentage of migrants in the city (Si et al 2016a).

FIGURE 3: Age of Household Members



The HCP survey categorizes households into five "types" based on the composition of members and their relationships to one another. Female-centred and male-centred households include a head without a spouse or partner and any combination of children, relatives, and non-relatives. They are distinguished from each other by the sex of the head. Nuclear and extended households include a head with a spouse or partner. The distinguishing feature between these two structures is that the nuclear household only includes children as additional members, whereas extended households include other members as well (e.g. parents, in-laws, grandparents, siblings and other relatives and non-relatives). Nuclear households represented the most common household type (57%) (Figure 4). This is followed by extended households, at 29% of the surveyed households. Female-centred and male-centred households were much less common household types, together making up only 13% of all households.

FIGURE 4: Distribution of Household Types



3.2 Economic Profile of Households

Households in Nanjing draw income from various sources. Formal wage work was the most common source of income and 55% of households had received income from this source in the previous month (Figure 5). The next most common sources of household income were government social grants (35%), net income from formal business (13%), informal wage work (8%) and casual wage work (7%). The informal economy in Nanjing is diverse. A total of 31 households received income from selling goods informally and 3% from producing and selling fresh produce, and 4% of households earned income from renting property informally. A small number (less than 2%) received income from selling fresh produce not produced by themselves and from other informal business.

Income from formal business was the highest average income amount in the previous month (approximately CNY10,113 or USD1,628) (Table 2). Although the amount received from bank loans was higher, the sample size was only eight households. Aside from formal business and bank loans, two other sources of income – interest from personal investments and wage work – also generated significant income. Income received from informal businesses was low. However, the informal sale of goods appears to be associated with the highest average amount earned across the informal business sources (not taking "other informal business" into account).

Total household income varied greatly with one household having made CNY300,000 (USD48,301) in the previous month and others reporting zero income in the same period. The first income quintile included households earning less than CNY3,000 (USD483) (Table 3). The highest income bracket was more than CNY10,808 (USD1,740) per month.

FIGURE 5: Distribution of Income Sources

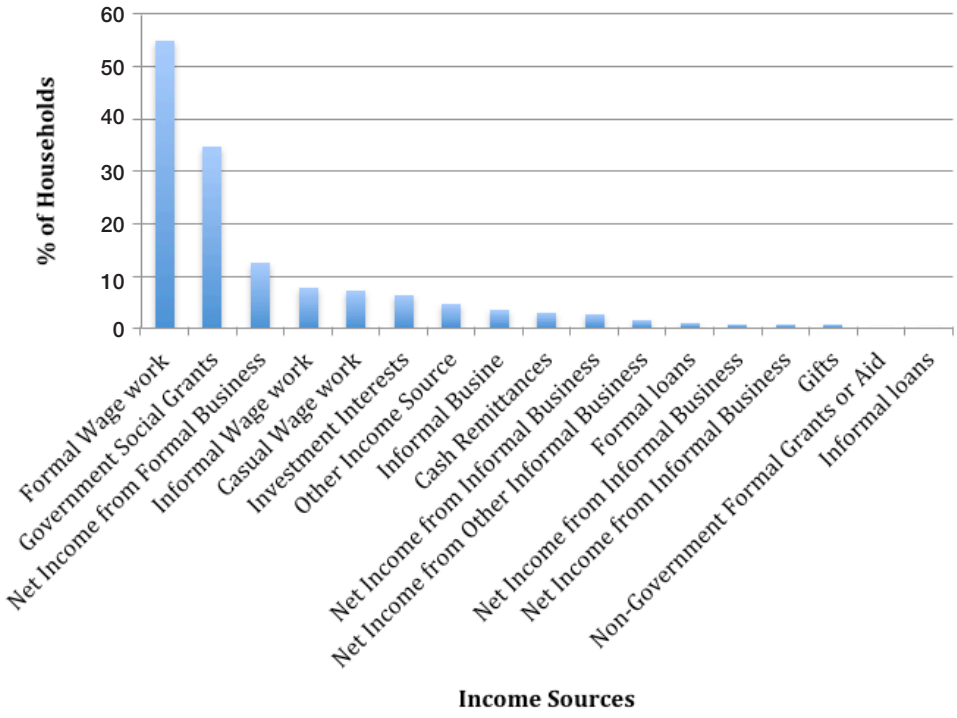


TABLE 2: Average Monthly Income Amount by Income Source

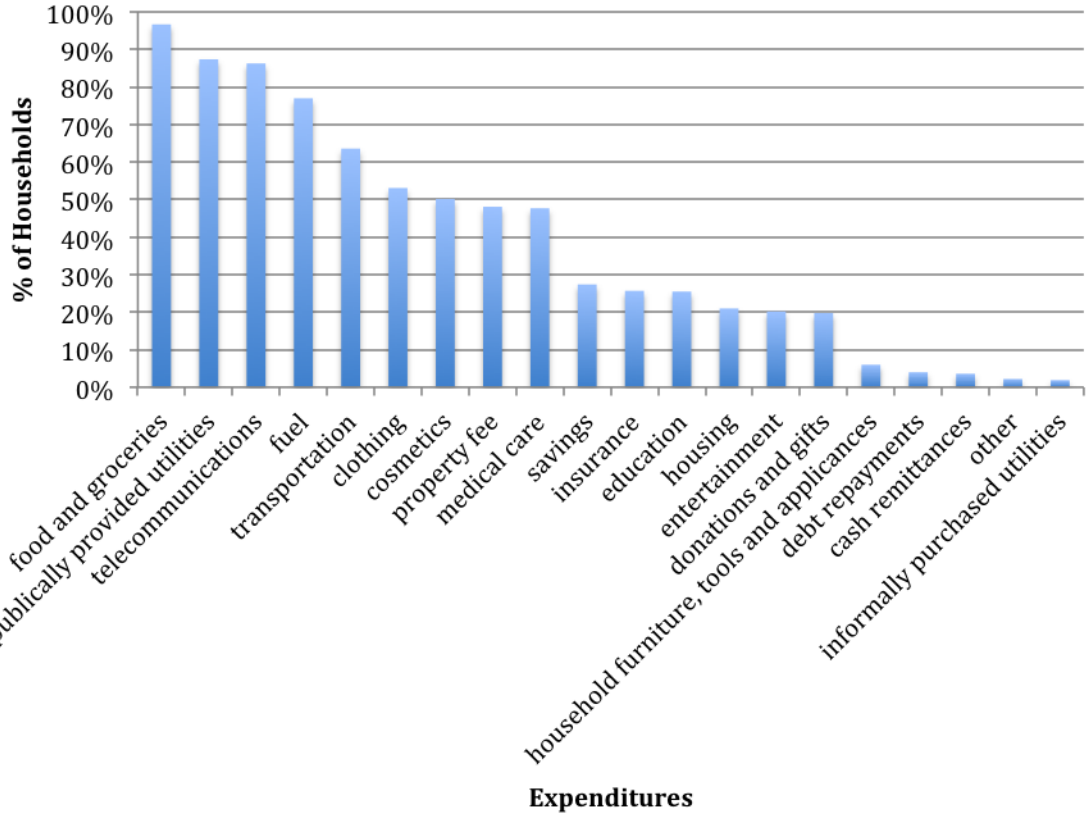
	No.	Mean (CNY)	Mean (USD)
Wage work (formal sector)	486	8,901	1,433
Government social grants	380	3,795	611
Net income from formal business	100	10,113	1,628
Wage work (informal sector)	86	5,034	810
Casual work (formal and informal)	79	3,583	577
Other income source mentioned	46	4,355	701
Net income from informal business (renting property)	38	2,885	464
Interest earned on personal investments	37	9,443	1,520
Cash remittances	26	2,102	338
Net income from informal business (sale of other goods)	21	4,464	719
Net income from other informal business	18	5,125	825
Formal loans (banks)	8	28,225	4,544
Net income from informal business (sale of fresh produce by household)	6	1,783	287
Net income from informal business (sale of fresh produce not produced by household)	6	2,083	335
Gifts	4	2,050	330

TABLE 3: Household Monthly Income Quintiles

Income quintiles	Yuan (CNY)	USD
1	<=3,000	<=483.00
2	3,001-5,000	483.01-805.00
3	5,001-7,350	805.01-1,183.36
4	7,351-10,808	1,183.37-1,740.10
5	>10,808	>1,740.10

Food and groceries are the most common household expenditure (incurred by 97% of surveyed households in the previous month) (Figure 6). Other common household expenditure items included public utilities and telecommunications (both incurred by more than 85% of households). Other expenditures incurred by more than 50% of households included fuel, transportation, clothing, and cosmetics. Furniture, tools and appliances, debt repayments, and cash remittances were rarely identified as household expenditures.

FIGURE 6: Distribution of Monthly Household Expenditures



The highest expenditures appear to have been on household furniture, tools and appliances, although the sample size is low for these items (Table 4). In addition, savings, housing, and debt repayments represented high average expenditure amounts. Expenditures on fuel, property fees, and telecommunication were small. The mean expenditure on food and groceries was CNY1,836 (USD296). The amount spent on food and groceries consistently increased with household income from USD177 for households in the lowest quintile to USD387 for those in the upper quintile (Table 5). The same pattern can be observed with virtually every other type of expenditure. The major exceptions are medical care (where average expenditures were highest in the third income quintile) and housing (where they were highest in the lowest income quintile).

TABLE 4: Average Monthly Expenditures

Expenditures	No.	Mean (CNY)	Mean (USD)
Food and groceries	977	1,836	296
Telecommunications (cellphone, telephone, internet)	910	204	33
Publicly provided utilities (water, electricity, sanitation and all taxes)	894	215	35
Fuel (charcoal, paraffin, kerosene, propane)	790	79	13
Transportation (purchase of cars, motorbikes, bicycles, maintenance, fuel, public transit, excludes insurance)	632	392	63
Clothing (excluding uniforms)	496	824	133
Medical care (visits to doctor, medications, supports, excludes insurance)	484	865	139
Property fee	477	68	11
Cosmetics	447	235	38
Education (tuition, books, uniforms)	243	1,346	217
Housing (rent, mortgage payments, maintenance, renovation)	220	3,007	484
Insurance (medical, vehicle, household, life)	215	989	159
Donations, gifts, family support (only to other households)	192	1,143	184
Entertainment (excludes goods and appliances)	175	714	115
Savings	160	4,243	683
Household furniture, tools and appliances (monthly purchases or monthly instalment payments)	47	4,776	769
Debt repayments	34	2,975	479
Cash remittances to rural areas	33	2,938	473
Other monthly expenses	24	841	135
Informally purchased utilities (water, electricity, sanitation)	14	76	12

TABLE 5: Household Expenditure by Income Quintiles

	I	II	III	IV	V
Food and groceries	177	229	227	305	387
Telecommunications	20	20	25	38	52
Publicly provided utilities	24	25	31	39	48
Fuel	10	11	11	14	15
Transportation	42	34	38	71	102
Clothing (excluding uniforms)	74	67	73	114	235
Medical care	69	98	203	151	172
Cosmetics	16	20	25	40	60
Education	107	135	150	165	368
Housing	855	387	256	444	531
Insurance	156	91	131	195	195
Donations, gifts, family support	173	150	209	178	209
Entertainment	85	76	55	144	117
Savings	275	221	310	596	1,229
Household furniture, tools and appliances	75	195	1,179	188	652
Debt repayments	188	276	346	577	601
Cash remittances to rural areas	129	795	242	200	204
Other monthly expenses	70	64	24	118	415
Property fee	7	8	9	12	15
Informally purchased utilities	1	15	0	57	2

3.3 Employment Profile

This section draws attention to the economic contributions of individuals within the household. Educational status is both a reflection of socio-economic status and a determining factor in the ability to earn adequate income. Among all the adult household members, 81% had at least finished primary school and around 20% had completed high school. A further 18% had some university-level education (Figure 7). Despite China's great advances in improving the educational level of its citizens, 7% of adult household members had no formal schooling. Of the adult population over the age of 18, nearly 40% were working full time and 27% were living on pensions. About 7% were working part-time, casually or seasonally (Figure 8). In general, the unemployment rate is relatively low. This is related to the high economic development level of Nanjing and the fact that it is the capital city of Jiangsu province.

FIGURE 7: Educational Level of Adult Household Members

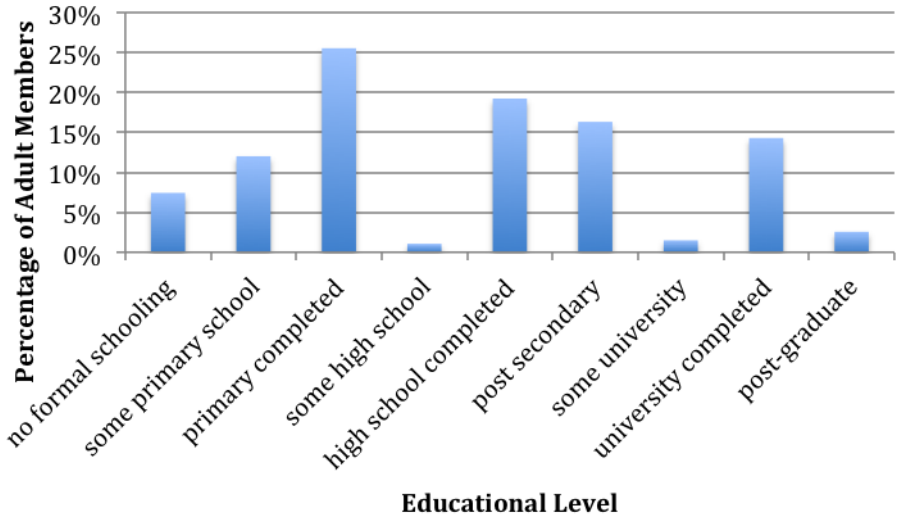
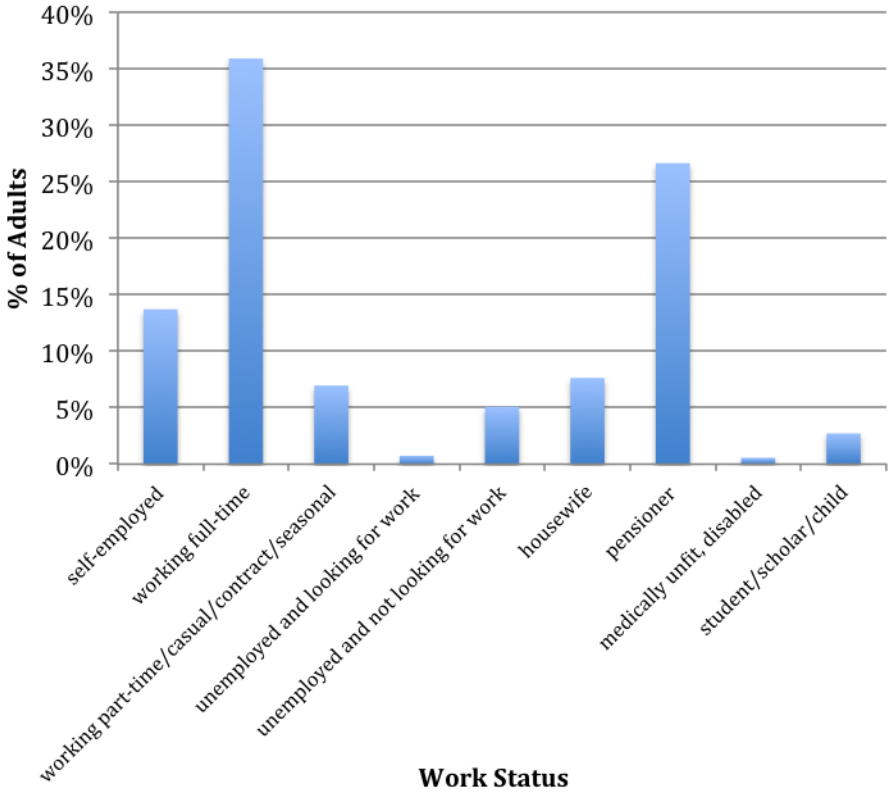


FIGURE 8: Work Status of Adult Household Members



3.4 Poverty Profile

The Lived Poverty Index (LPI) provides a reliable subjective experiential index of "lived poverty". The LPI is based on how often people report being unable to secure basic needs and infrastructure: food, clean water, medicine/medical treatment, electricity, fuel to cook food, and a cash income. Responses are grouped together into a single index on a scale that ranges from 0 (never going without in the previous year) to 4 (always going without); the higher the LPI value, the greater the degree of lived poverty. Just over 20% of households had gone without electricity at least once and 14% had gone without enough clean water for home use at least once (Figure 9). However, other basic necessities were well supplied in the city: less than 5% of households had experienced a lack of food, medicine or medical treatment, fuel to cook food, or cash income.

The low levels of lived poverty suggested by these frequencies are confirmed by the low LPI scores. A total of 71% of households had an LPI score of 0 and another 28% were in the range of 0.01-1.00. Only 1% of households have a LPI score over 1.00 (Figure10). No household had an LPI score above 2.00. The mean household score was only 0.1021, with every indicator also having a mean score of less than 1.00 (Table 6). Significantly, lack of access to food was at 0.05, which was one of the lowest average scores, suggesting that food access was high. The vast majority of households in Nanjing had therefore never experienced a lack of basic living resources in the year prior to the survey.

FIGURE 9: Access to Basic Services and Necessities

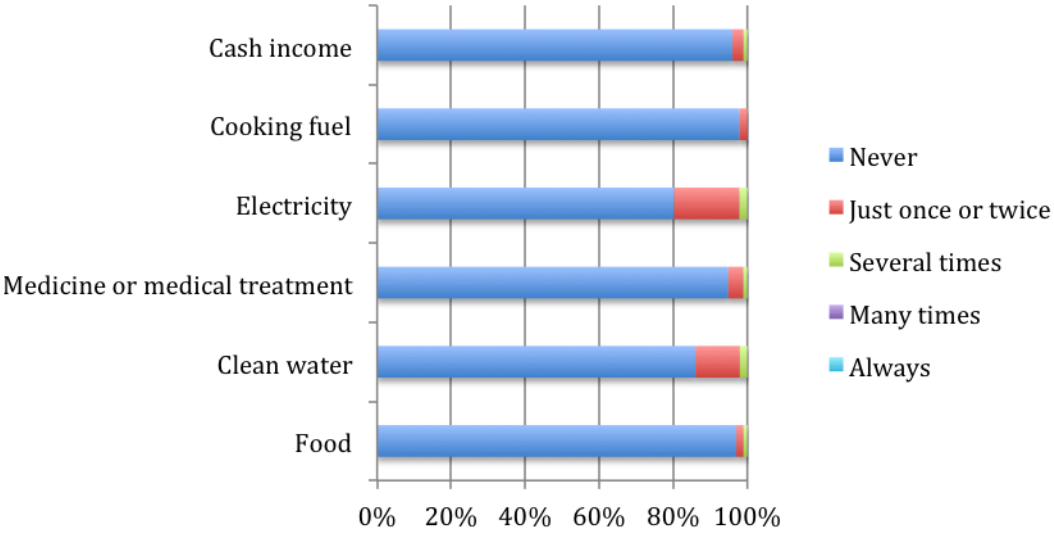


FIGURE 10: Distribution of LPI Categories

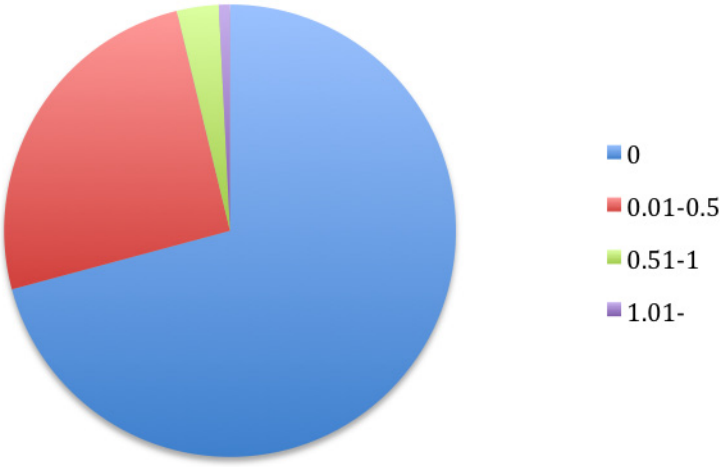


TABLE 6: Lived Poverty Index Scores

	Lack of access to food	Lack of access to water	Lack of access to medicine or medi-cal care	Lack of access to electricity	Lack of access to cooking fuel	Lack of access to cash income	Total LPI
Mean	0.05	0.17	0.06	0.24	0.03	0.07	0.10
Standard deviation	0.29	0.47	0.32	0.52	0.21	0.35	0.21
N	1,163	1,164	1,170	1,172	1,171	1,168	1,152

3.5 Social Grants

Figure 11 indicates that 41% of households were receiving social grants at the time of the survey. Old-age pensions were the most common social grant received (by nearly a third of households). About one in 10 households received food for work but other possible types of social grant were rare. Grant-receiving households received an average of CNY2,492 (USD401) per month although there was wide variation in the amounts received. The majority of social grant recipients used them for paying for food and groceries (Figure 12). Other uses included paying for utilities, household items, medical expenses, savings, and buying clothing.

FIGURE 11: Types of Social Grants

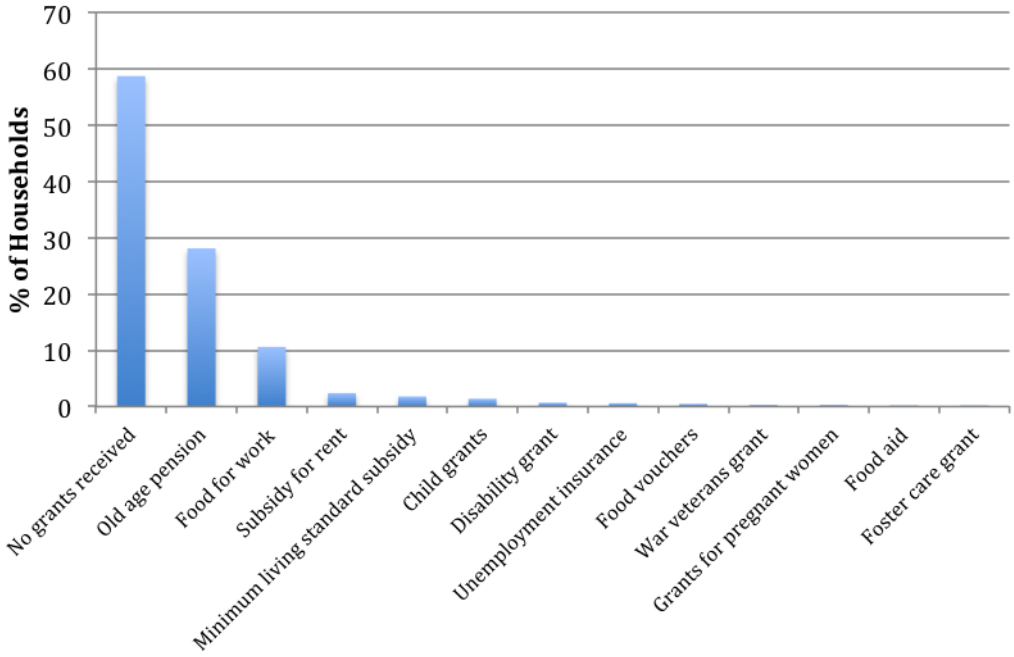
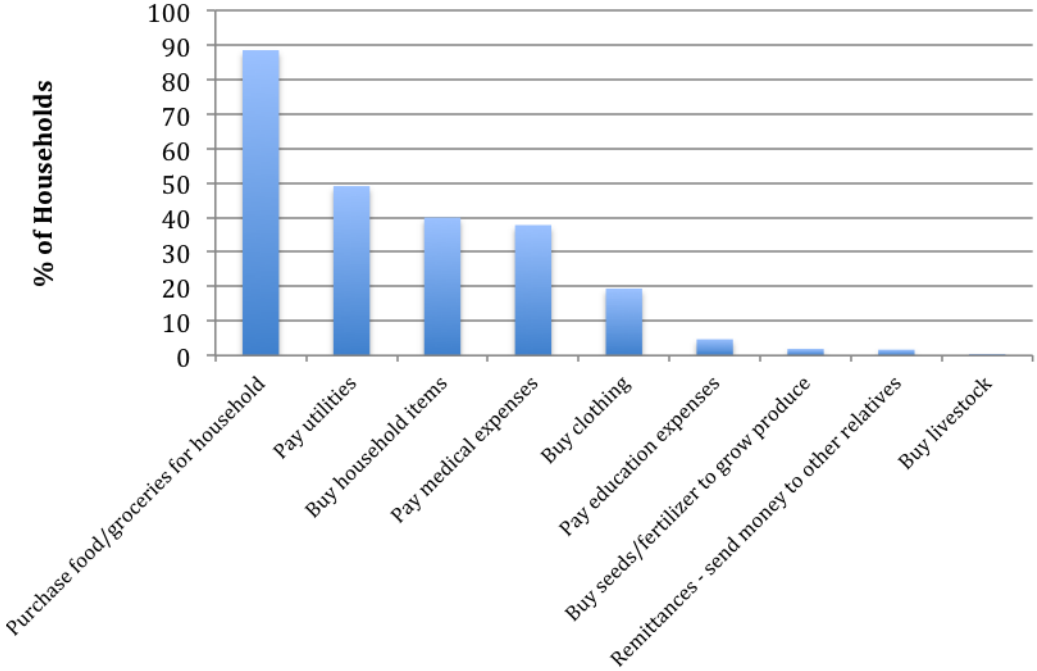


FIGURE 12: Uses of Social Grants



4. Household Food Security

Household food insecurity is multi-dimensional and highly contextual. The HCP survey focuses on household experiences of food deprivation, constrained access, and dietary choices to develop a picture of the food security situation in each city. The HCP uses the food security assessment methodology developed by the Food and Nutrition Technical Assistance (FANTA) project (Swindale and Bilinsky 2006a). FANTA conducted a series of studies exploring and testing alternative measures of household food insecurity in a variety of geographical and cultural contexts and developed widely used indicators and scales to measure aspects of food insecurity. There are four main metrics:

- Household Food Insecurity Access Scale (HFIAS): The HFIAS score is a continuous measure of the degree of food insecurity in the household (Coates et al 2007). It draws attention to the consistency of a household's access to food. An HFIAS score is calculated for each household based on answers to nine frequency-of-occurrence questions designed to capture different components of the household experience of food insecurity in the previous four weeks. The minimum score is 0 and the maximum is 27. The higher the score, the more food insecurity the household experienced. The lower the score, the less food insecurity the household experienced.
- Household Food Insecurity Access Prevalence (HFIAP) indicator: The HFIAP indicator is based on the HFIAS and uses a scoring algorithm to categorize households into four levels of household food insecurity: food secure, mildly food insecure, moderately food insecure, and severely food insecure (Coates et al 2007). Households are categorized as increasingly food insecure as they respond affirmatively to more severe conditions and/or experience those conditions more frequently.
- Household Dietary Diversity Score (HDDS): Dietary diversity refers to how many food groups are consumed within the household in the previous 24 hours (Swindale and Bilinsky 2006b). The scale runs from 0 to 12 with 0 indicating that no food was consumed and 12 indicating that food from all 12 food groups were consumed in the previous 24 hours. An increase in the average number of different food groups consumed provides a quantifiable measure of improved household dietary diversity.
- Months of Adequate Household Food Provisioning (MAHFP) indicator: The MAHFP indicator captures changes in the household's ability to ensure that food is available above a minimum level throughout the year (Bilinsky and Swindale 2007). Households are asked to identify in which months (during the past 12 months) they did not have access to sufficient food to meet their household needs. A score is calculated by subtracting the number of months of inadequate food from 12.

4.1 Household Food Access

Nanjing households have very high levels of food security. The average HFIAS score was only 0.61 out of 27. The positive food security picture is further verified by the overall distribution of HFIAS scores and the fact that 95% of surveyed households scored less than 3 (Figure 13).

The individual questions from which the HFIAS score is calculated confirm that very few households experience any of the usual symptoms of food insecurity (Figure 14). For example, 97% of households said that they had not worried that they would not have enough food in the previous four weeks. Similarly, 98% of households did not have to eat fewer meals in a day, 97% did not have to eat smaller meals, and 95% did not have to eat food that they did not want to eat. The only indicators where a few households answered that they were negatively affected were eating a limited variety of food and not eating preferred foods. However, over 80% of households did not experience either of these dietary limitations.

When the HFIAS results are converted into the four HFIAP categories using the FANTA algorithm, about four in five households (79%) were classified as food secure (Figure 15). Mildly food insecure households were the next largest share (14%), 5% were moderately food insecure, and only 2% were severely food insecure.

FIGURE 13: Distribution of HFIAS Scores

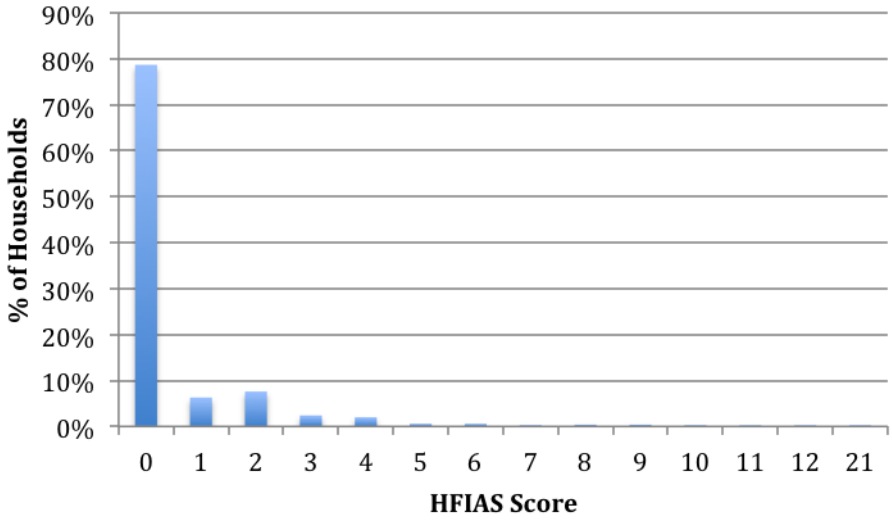


FIGURE 14: Responses to HFIAS Food Security Questions

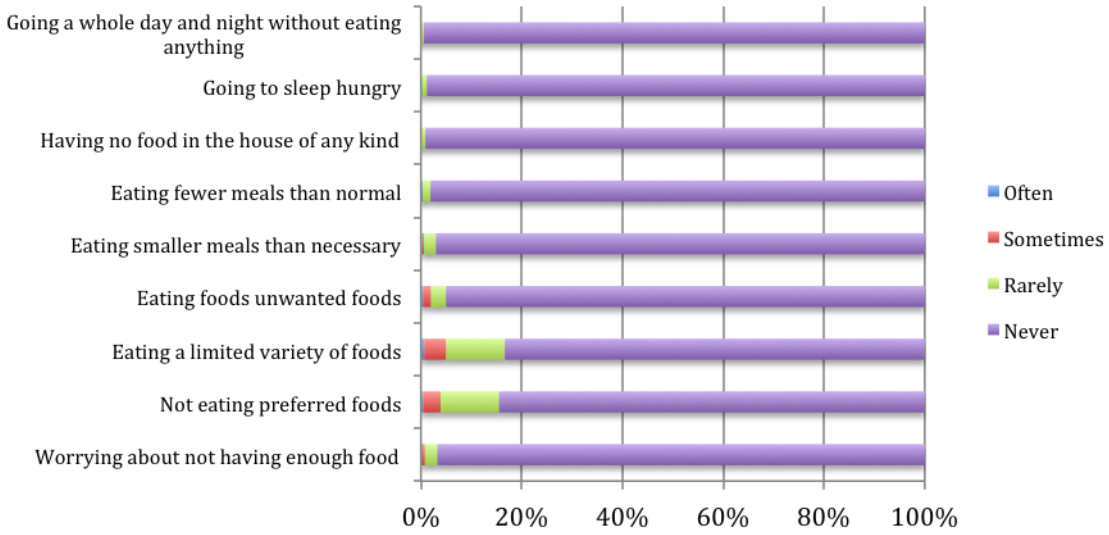
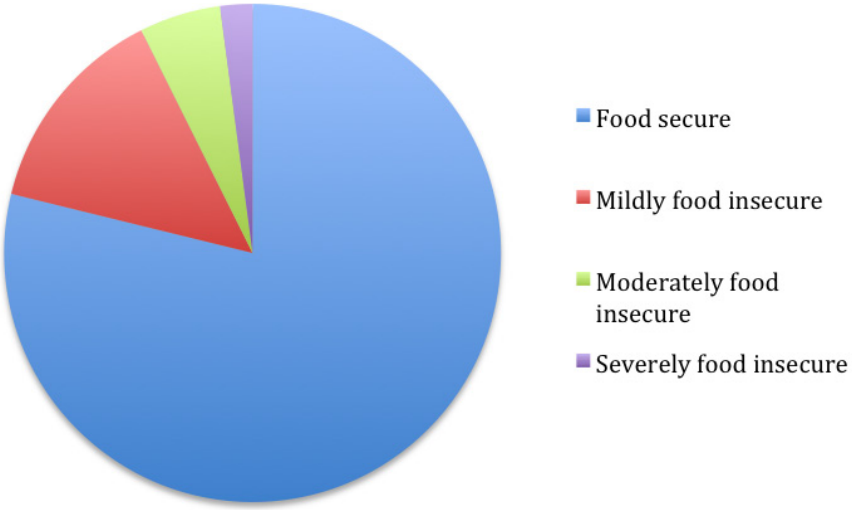


FIGURE 15: HFIAP Classification



The household dietary diversity scores indicate that Nanjing households have a very diverse diet. The mean HDDS was 7.8, with a median number of 8 out of a possible 12. Only 10% of households had eaten food from fewer than four food groups in the 24 hours before the survey was conducted (Figure 16). Nearly two-thirds of households (63%) had eaten foodstuffs from eight or more food groups.

The most frequently consumed food type was staple grains (steamed buns, rice noodles, biscuits, or any other foods made from millet, sorghum, maize, rice or wheat), with 98% of households consuming foods from that group (Figure 17). The second most commonly consumed food type was vegetables (97%), followed by fruits (80%), meat (79%) and eggs (79%). The least commonly consumed food was roots or tubers (34%) and fish or shellfish (37%). About 66%

of households reported that they ate dairy products, 45% consumed beans, peas, lentils or nuts and 40% consumed sugar or honey. The prominence of dairy products is potentially an indication of the westernization of the dietary pattern of Chinese urban residents (see Garnett and Wilkes 2014, Sharma and Rou 2014). It is interesting to note that, although Nanjing is located in an area rich in water bodies, fish and shellfish were consumed much less frequently compared to other food groups by the surveyed households. This is probably due to the high market price of fish and shellfish.

FIGURE 16: Household Dietary Diversity Scores

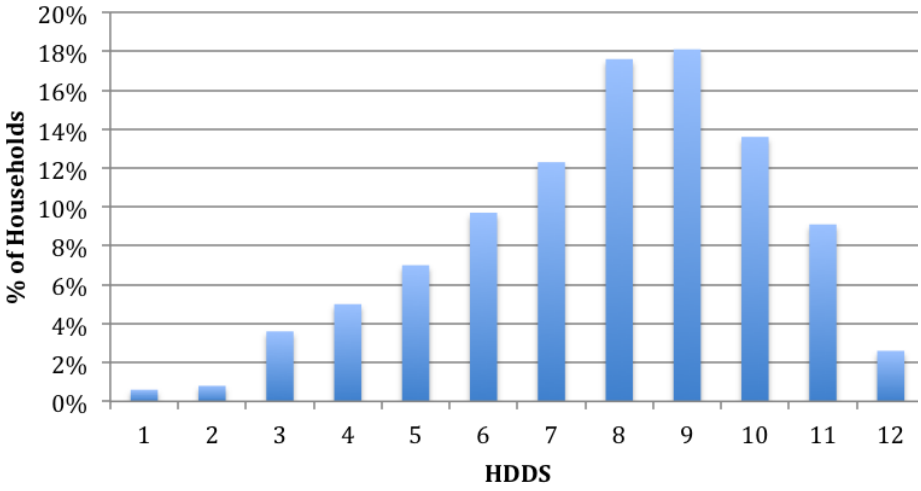
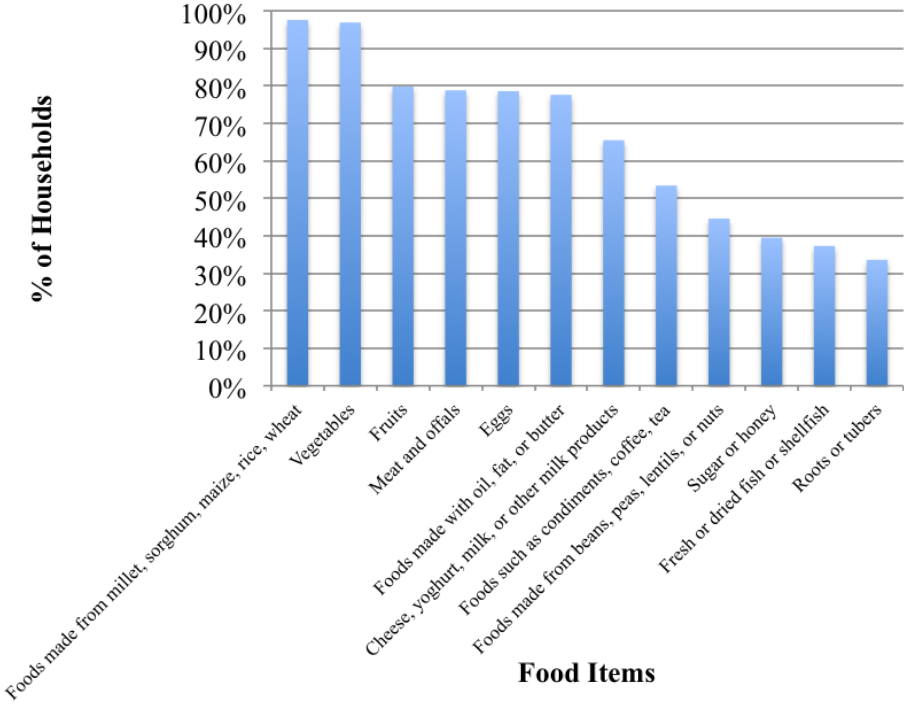


FIGURE 17: Food Groups Consumed by Households



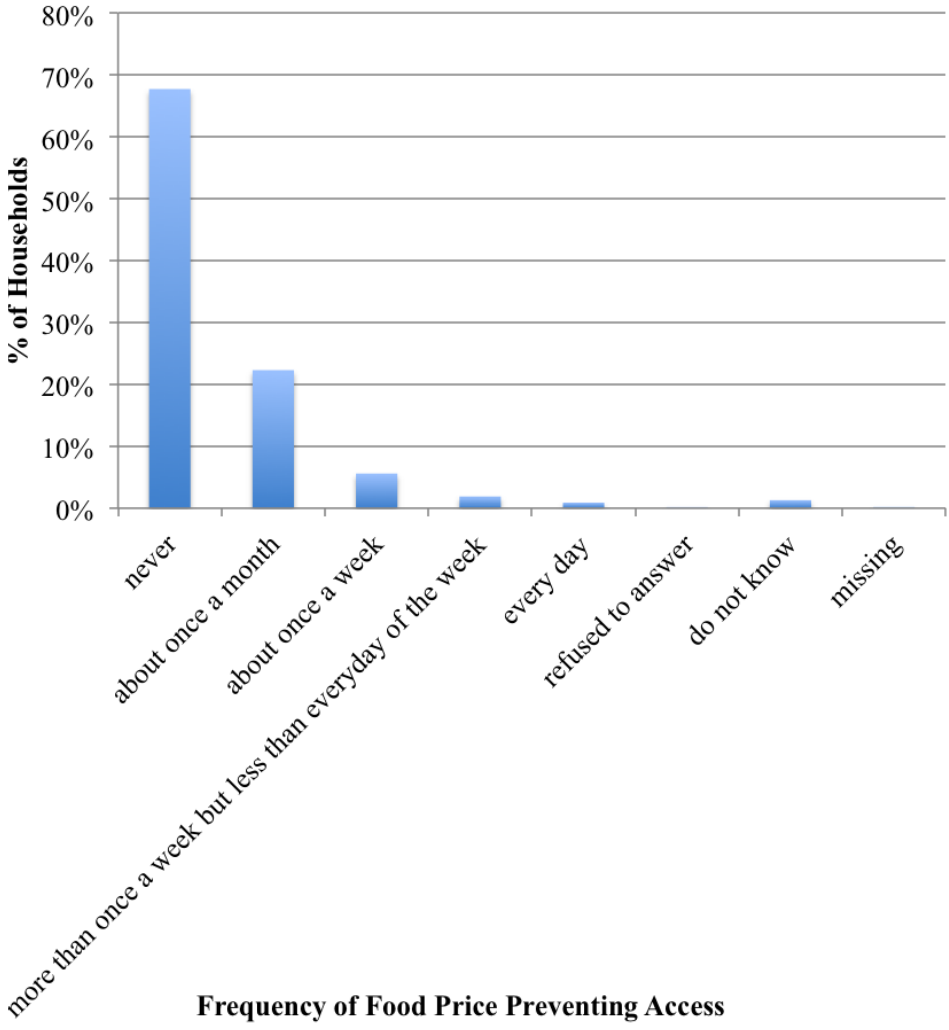
4.2 Adequacy of Household Food Provisioning

The average MAHFP of surveyed households in Nanjing was 11.99, which indicates a very high level of food security. Fewer than 10 households reported inadequate access to food in one or more months during the past year.

4.3 Impact of Food Price Increases

For most of the surveyed households, food price was not an obstacle to food access. Two-thirds of households said that they never had to go without food due to its affordability. However, more than 30% of the surveyed households said that they had gone without certain types of food due to rising food prices in the previous six months (Figure 18).

FIGURE 18: Food Price Change Impacts on Food Access



"Meat and offal" was the most frequently mentioned food group that households went without due to high food prices. Two-thirds of the households whose food access was affected by rising food prices indicated that this was the food group that they had given up (Figure 19). The second most often indicated food group was fish and shellfish, followed by fruit and vegetables. The least frequently mentioned food group was roots and tubers. The statistics reflected the gap between desirability and affordability of each of the food groups in Nanjing. They could also suggest which food groups are rising in price more rapidly.

FIGURE 19: Food Groups Affected by Rising Prices

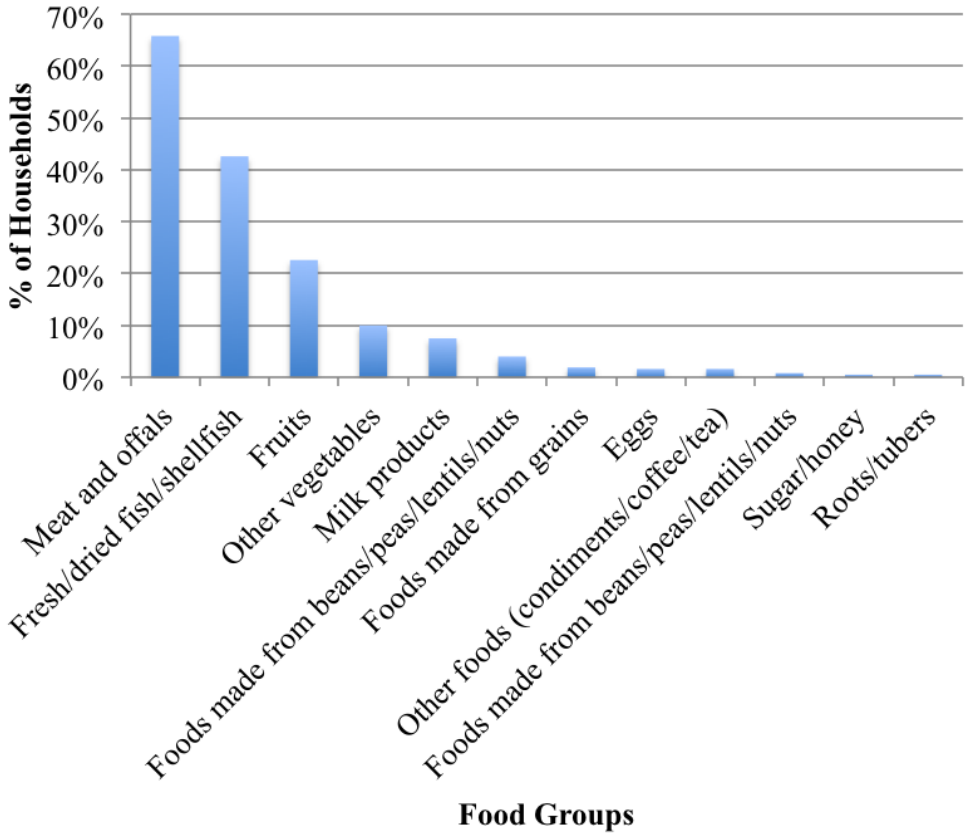
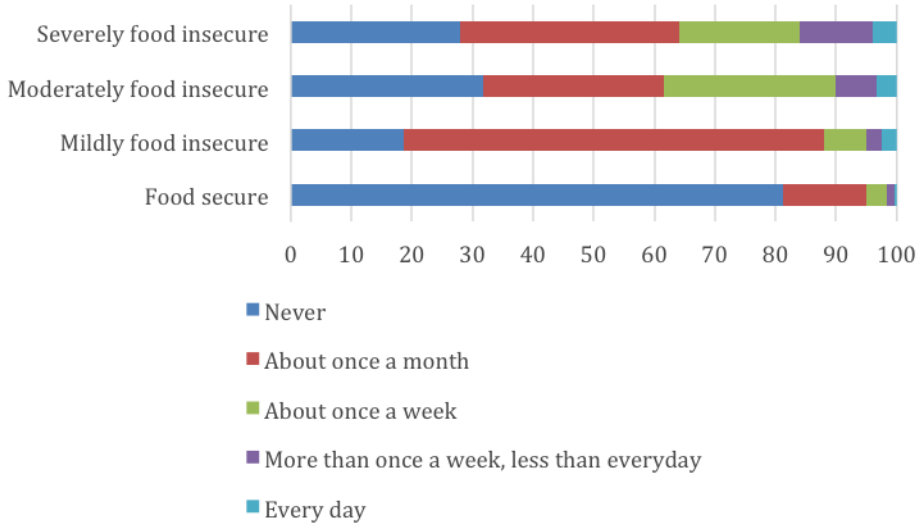


Figure 20 shows predictably that food price increases had the least impact on food secure households. The vast majority (80%) of food secure households did not have to give up any types of food because of the high price. In contrast, mildly food insecure households were most sensitive to food price increases with 82% of mildly food insecure households reporting going without certain types of food because of price. This figure was actually higher than for moderately and severely food insecure households. This is probably due to the fact that severely food insecure households were already consuming the cheapest food due to constraints of resources. Thus, they were less sensitive to food price increases than mildly food insecure households.

FIGURE 20: Frequency of Going Without Food Due to Rising Food Prices



5. Household Characteristics and Food Security

In this section, food security scores are cross-tabulated with household characteristics to gain a more detailed view of the factors that shape food security in Nanjing. This section examines food security scores in relation to household structure, household income, household size, whether the household receives income from formal employment, and whether the household practises urban agriculture.

5.1 Household Type and Food Security

The relationship between household type and food security levels varies among the different food security indices. Extended households had the highest HDDS (8.4) while male-centred households had the lowest (6.6), although female-centred households also had a low mean HDDS (6.8) (TABLE 7). In terms of the HFIAS, female-centred households were less food secure compared to other households (with the highest HFIAS). The average MAHFP turned out to be roughly the same for all household types. Male-centred and female-centred households were relatively food insecure compared to nuclear and extended households. This is probably due to lower household income as many nuclear and extended households had two people working. These findings also reflect broader issues of gender inequality that often manifest as food insecurity (Riley and Caesar 2017).

TABLE 7: Average Food Security Scores by Household Type

Household types	Average HDDS	Average HFIAS	Average MAHFP
Female-centred	6.8	1.75	11.92
Male-centred	6.6	0.75	11.97
Nuclear	7.9	0.46	12.00
Extended	8.4	0.56	11.99

5.2 Household Income and Food Security

Higher household income was associated with higher HDDS, yet the difference among different income groups was not very significant. The first (poorest) quintile had an average HDDS of 7.1, while the third, fourth and fifth quintiles ranged between 8.3 and 8.4. This suggests that, above a certain threshold, dietary diversity does not increase with increased income. The same picture was also found in the comparison of HFIAS of different income groups. The average HFIAS for all quintiles was 1.22, 0.71, 0.33, 0.44 and 0.44 respectively, indicating that only the lowest two quintiles were notably more food insecure. In contrast to the HFIAS and HDDS, the average MAHFP did not differ significantly with level of income.

TABLE 8: Food Security Scores by Household Income Terciles

Income quintile	Average HDDS	Average HFIAS	Average MAHFP
1	7.1	1.22	11.95
2	7.6	0.71	12.00
3	8.3	0.33	12.00
4	8.3	0.44	11.98
5	8.4	0.44	11.99
Total	7.9	0.66	11.98

5.3 Household Size and Food Security

The relationship between household size and dietary diversity was not as obvious, although households with only one member had the lowest HDDS (Table 9). The average HDDS for households with a single member was only 6.0. In contrast, the HDDS of all other households was 7.0 or higher. The average HFIAS score does not correlate with household size, although the score for households with a single member was significantly higher (1.66) than that of households with two or more members (0.75 or lower). This indicates a lower level of household food security for these single-member households. All households had very high MAHFP scores, showing that there was no significant food shortage in any month over the previous year.

TABLE 9: Average Food Security Scores by Household Size

No. of household members	Average HDDS	Average HFIAS	Average MAHFP
1	5.95	1.66	11.98
2	7.67	0.51	11.99
3	8.06	0.45	11.99
4	7.74	0.60	11.98
5	8.61	0.59	12.00
6	8.28	0.23	11.94
7	8.33	0.00	12.00
8	8.00	0.75	12.00
9	7.00	0.00	12.00

5.4 Formal Employment and Food Security

Whether the household had formal wage work as an income source was closely related to the household food security status in terms of the average HDDS and HFIAS (Table 10). Households with formal wage work as an income source in the past month had a higher HDDS (8.1) and lower HFIAS (0.38), compared to households with no formal wage work income. The average MAHFP did not differ significantly. These findings suggest that formal wage work plays a role in protecting households from food insecurity.

TABLE 10: Food Security and Formal Wage Work as Income Source

	Average HDDS	Average HFIAS	Average MAHFP
Yes	8.1	0.38	11.99
No	7.5	0.89	11.98

5.5 Urban Agriculture and Food Security

On average, households conducting urban agriculture in Nanjing were slightly more food secure in terms of both HFIAS and HDDS (TABLE 11), although the difference is not as great as for income from formal employment. This might be because urban agriculture enhances households' accessibility to diverse food, or it could be that better-off households can afford to invest in food production that enhances their access to food. The difference of MAHFP between households that conducted or did not conduct urban agriculture indicated the opposite result but the difference was very minimal.

TABLE 11: Food Security and Participation in Urban Agriculture

	Average HDDS	Average HFIAS	Average MAHFP
Yes	7.9	0.57	11.98
No	7.8	0.61	11.99

6. Household Food Sources

The HCP survey included a number of questions pertaining to sources of food for households in Nanjing and the frequency of patronage. In addition, the Hungry Cities Food Purchases Matrix (HCFPM) collected detailed information on the purchasing patterns for 40 individual food items (Crush and McCordic 2017). This section combines these results to present a picture of the urban food system of Nanjing from the point of view of household production and consumption.

6.1 Major Food Sources

Wet markets and supermarkets are the main household food sources in Nanjing. Both are more densely distributed in core urban districts, including Gulou, Xuanwu, Qinhuai, Jianye, Yuhuatai and Qixia (Figure 21). These districts have the most residential households as well. The number of wet markets is much higher than that of supermarkets, making wet markets the most important food source for daily food purchase.

Wet markets are the most important source of food purchase in terms of frequency of access. While it does not indicate the amount of food purchased or money spent at a given outlet, purchasing frequency still reflects the relative significance of different food outlets. The vast majority (93%) of households had accessed food from wet markets in the previous year (Figure 22). Among these patrons, 75% visited wet markets at least five days a week, indicative of the easy accessibility of wet markets in Nanjing. In contrast, among the 87% of households that had visited supermarkets in the previous year, only 17% visited at least five days a week.

FIGURE 21: Distribution of Wet Markets and Supermarkets in Nanjing

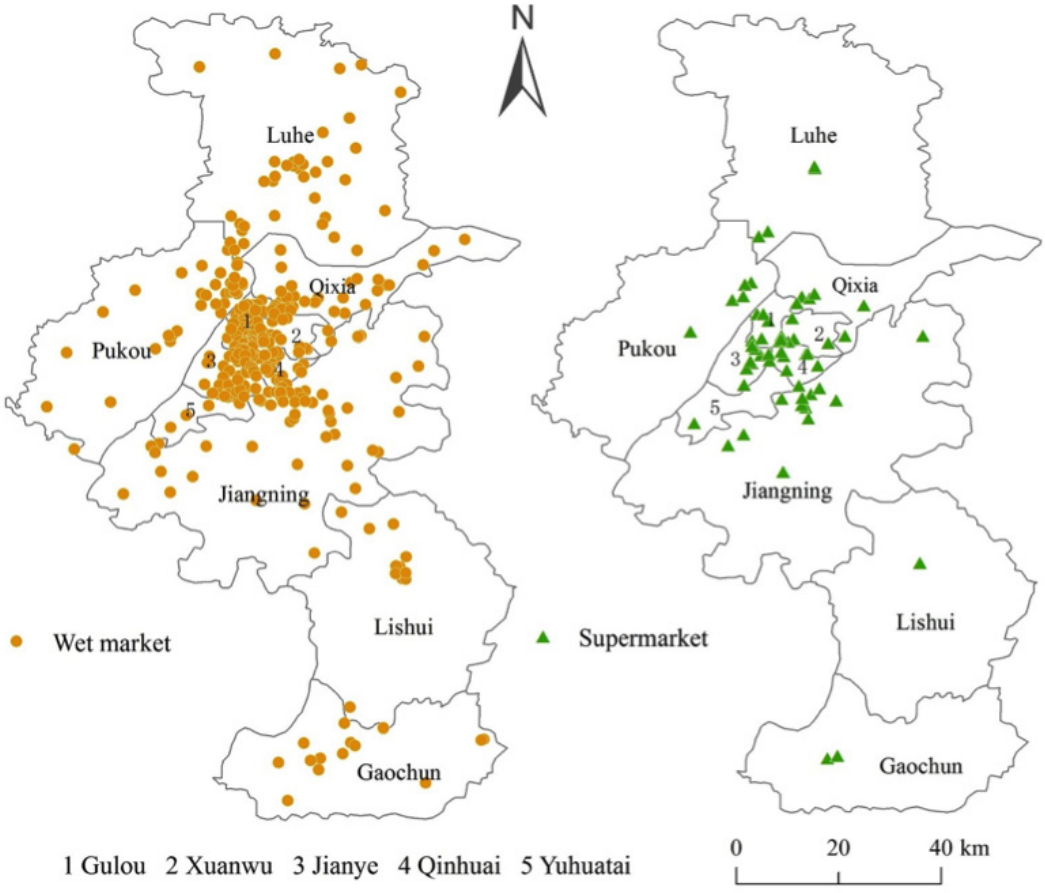
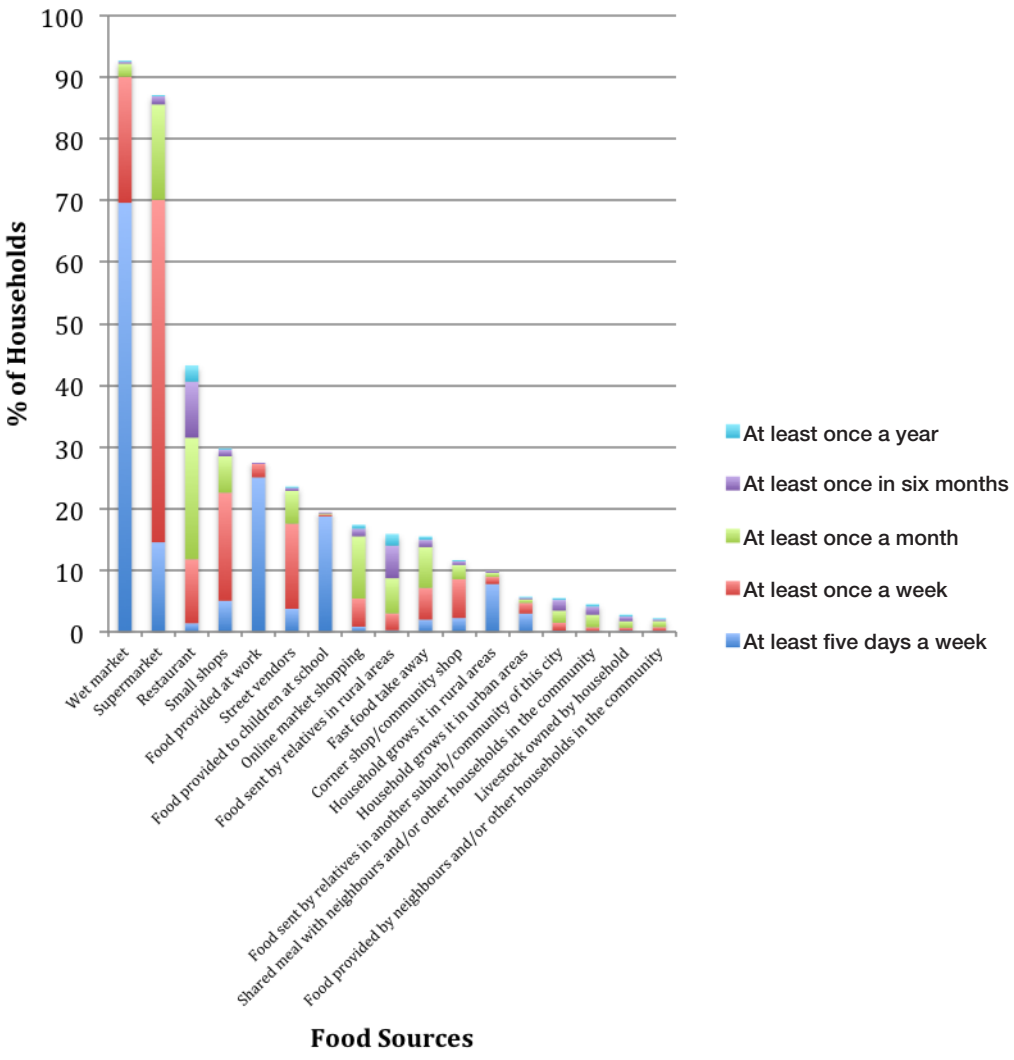


FIGURE 22: Frequency of Accessing Food from Different Sources in the Previous Year



The third most frequently used food source was restaurants. Among the 43% of households who had visited restaurants in the past year, nearly half had eaten there at least once a month. Interestingly, 17% of households had shopped online for food in the year prior to the survey, which illustrates the growing popularity of e-commerce of food. Other sources include grocers, cafés, butchers and small shops, food provided at work, street vendors, and food provided to children at school. Almost no households reported begging for food, using a community food kitchen, or borrowing food from others. The data indicate that, besides purchasing food ingredients at wet markets and supermarkets, restaurants were important food venues for Nanjing residents. Fast food restaurants were particularly popular.

Entrance to Wet Market and Adjacent Supermarket

Fruit and Vegetable Outlet in Wet Market

Interior of Nanjing Supermarket

Nanjing Restaurant

Nanjing Wholesale Market

Food Price and Sales Monitoring at Nanjing Wholesale Market

Food Safety Lab at Nanjing Wholesale Market

6.2 Food Purchasing Patterns

Vegetables and fresh fruits were the most commonly purchased food items in the list of foods in the HCFPM (Figure 23). Fresh pork ranked third, which reflects the dominant position of pork in meat consumption in China. The fourth item was the major staple food in Nanjing – rice – followed by eggs, noodles, fresh fish, and cooking oil. While milk is not part of the traditional diet in China, 60% of households had purchased milk in the 30 days prior to the survey and the number for powdered milk/yoghurt was also high (47%). The high percentage of dairy product purchases indicates the westernization of urban Chinese diets. Among meat and seafood items, fish, chicken, and beef were the most common after pork.

In terms of the frequency of purchase, most households purchased fresh/cooked vegetable items at least five days a week. As noted above, this indicates easy access to vegetable outlets, mainly wet markets, and a strong local vegetable supply network in Nanjing (Zhong et al 2018). It also reflects the importance attached by Nanjing residents to the freshness of vegetables, which is a long-standing tradition among Chinese consumers. The frequency of purchase was also high for fresh milk. Almost 40% of households that purchased milk did so on a daily basis. The purchasing frequency for pork and fresh fish was at least once a week. The least frequently purchased items were cooking oil and rice, which are typically purchased in bulk (Figure 23).

FIGURE 23: Purchasing Frequency of Popular Food Items

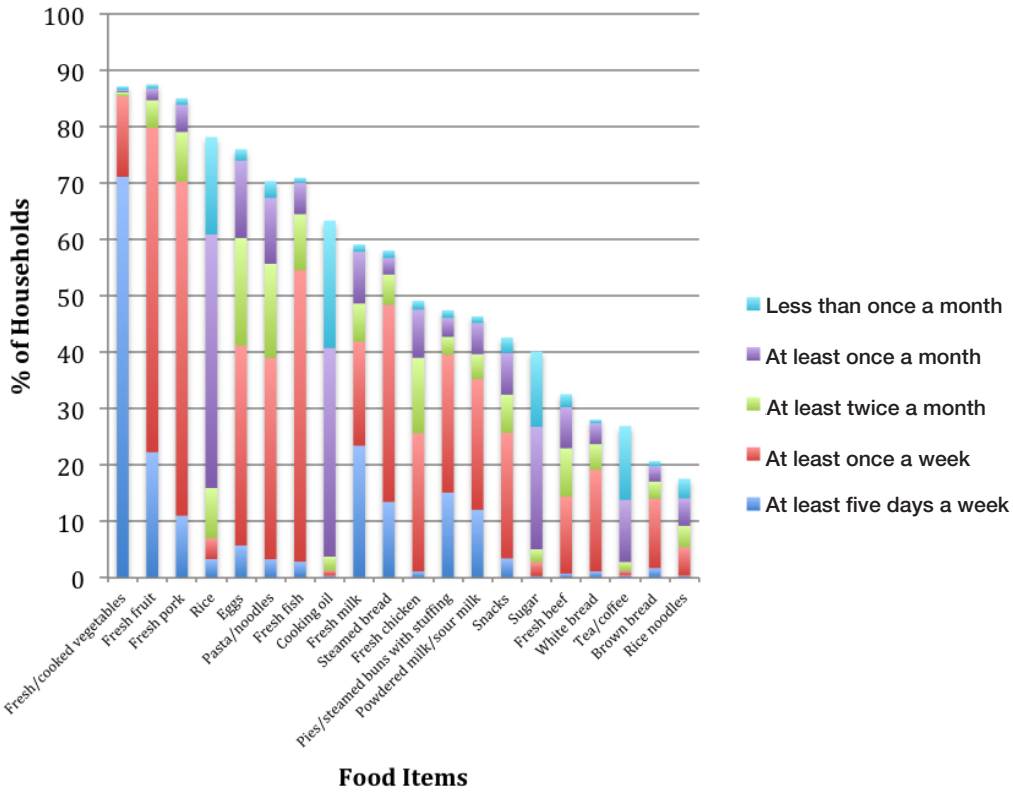


Table 12 shows the main food outlets where households purchased each food item in the HCFPM. Shaded cells in the table indicate instances where more than 50% of surveyed households purchased a food item at that source. Empty cells indicate instances where no surveyed households purchased a food item at that source. Of the 40 food items, 22 food items were shaded for supermarkets, while 17 were shaded for wet markets (four items were shaded for both supermarkets and wet markets). However, the proportion of households purchasing these items at all was much higher for wet market purchases than supermarket purchases.

Food items more commonly purchased in supermarkets included staple grains (rice), dairy and eggs (eggs, fresh milk, and powdered milk/yoghurt), and processed food (including pasta/noodles, cooking oil, snacks, sugar, white bread, tea/coffee, brown bread, rice noodles, sweets/chocolate, chips/French fries, tinned/canned vegetables, frozen pork, tinned/canned fruit, frozen beef, frozen lamb, cooked lamb, frozen shellfish, and tinned/canned meat). Food items more commonly purchased in wet markets included fresh produce (vegetables and fresh fruits), fresh animal products (pork, chicken, fish, beef, lamb, shellfish, and offal), frozen meat (fish and chicken), cooked meat (pork, chicken, beef, and shellfish), steamed bread, and pies or steamed buns with stuffing.

The HCFPM demonstrates that traditional markets (wet markets) still dominate the purchase of fresh produce and meat, especially fresh/cooked vegetables, fresh pork, fresh fish, and fresh chicken in the city of Nanjing. Supermarkets, on the other hand, are the top choice for processed food, cooking oil, rice, fresh milk, eggs, and noodles. Online shopping purchases were mainly snacks. This is probably due to the challenge of delivering fresh food over a long distance. At small shops/grocers/cafés, people mainly bought steamed bread and buns, and cooked chicken. Fresh fruit and steamed buns/fried dough are purchased from street vendors for their affordability and convenience. Restaurants are also commonly used to get cooked food.

TABLE 12: Food Purchases by Food Source

	Percentage of households purchasing each food at each source											
	% of households buying food	Supermarket	Online market	Small shop	Butchery or bakery	Take away	Restaurant	Wet market	Informal market	Corner shop/ community shop	Street seller	Other
Cooked beef	16.7	30.7	0.5	20.3	20.8	5.0	7.4	47.0	1.5	3.5		0.5
Cooked chicken	7.2	33.3		33.3	12.6	13.8	19.5	35.6		1.1	1.1	1.1
Cooked fish	1.9	21.7		4.3	4.3	17.4	65.2	21.7				
Cooked shellfish	0.5	16.7		0.0	0.0	0.0	50.0	33.3				
Cooked pork	6.0	33.3		15.3	19.4	9.7	23.6	36.1	1.4		2.8	1.4
Cooked lamb	1.0	66.7	8.3	8.3	8.3	8.3	16.7	16.7				16.7
Pies or steamed buns with stuffing	47.9	11.2		35.4	3.5	8.1	1.0	34.2	1.0	9.8	17.1	1.0
Fresh or cooked vegetables	87.8	22.1	0.4	2.0	0.2	0.5	1.7	92.6	3.3	0.6	4.9	1.9
Fresh fruit	87.8	45.9	1.5	22.8	0.2	0.2	0.1	59.2	3.6	3.4	18.5	1.0
Fresh pork	85.9	25.6	0.1	1.3	13.9	0.1	1.0	83.8	1.8	0.4	1.0	0.1
Fresh beef	33.0	34.1	0.5	0.5	11.3		1.0	76.7	1.3		0.3	0.8
Fresh lamb	5.9	40.8	2.8	2.8	9.9			67.6	1.4		1.4	
Fresh chicken	49.3	24.1		0.7	6.4	0.2	0.5	87.6	1.7	0.3	1.2	0.3
Fresh fish	71.7	17.6		0.5	0.9		0.8	92.4	1.4	0.6	0.7	1.6
Fresh shellfish	10.6	44.5	0.8	0.8	1.6	0.8	1.6	68.0	0.8	0.0	0.0	0.0
Kidney, liver, tripe (offal)	15.0	20.9	0.5	3.3	4.9		1.6	85.2	1.1	0.5		0.5

Eggs	77.5	59.7	0.3	5.5		0.3	0.5	55.9	1.5	1.5	1.1	4.2
Fresh milk	59.6	65.3	3.9	10.4			0.1	5.5	0.1	1.1	0.1	27.9
Powdered milk, sour milk	46.8	82.3	1.4	9.9				3.5		1.8		13.4
White bread	28.9	76.3	1.1	9.7	31.7	0.3	0.3	5.4		0.9	0.3	0.6
Brown bread	21.0	73.2	0.8	9.8	40.6	0.4	0.0	4.3	0.0	1.2	0.0	0.0
Steamed bread	58.3	28.5	0.4	28.9	6.5	4.2	0.3	32.7	1.7	9.5	10.8	1.7
Rice	79.4	71.7	1.7	13.2	0.3	0.8	1.9	25.3	0.8	2.4	0.8	5.3
Rice noodles	17.6	70.9	2.3	12.2	1.4	1.9	5.6	34.7	0.9	4.7	0.5	0.9
Pasta	71.6	58.2	1.0	15.2	0.1	0.9	4.2	40.9	0.6	4.8	0.7	0.7
Chips	15.7	94.2	12.6	19.5		1.1	0.5	2.6		5.8		0.5
Sweets or chocolate	17.2	91.3	13.9	16.3	1.0			3.4		4.8	0.5	0.5
Snacks	43.1	92.0	12.1	24.9	0.6			4.2	0.2	6.1	0.8	0.4
Cooking oil	64.9	89.0	1.0	4.1		0.1	0.3	9.6	0.9	0.4	0.1	3.3
Sugar	40.9	88.3	2.0	14.5	0.2		0.2	7.5	0.2	2.4		0.8
Tea or coffee	27.9	75.7	8.0	16.9			0.9	4.5	0.3	2.1	0.3	8.0
Tinned meat	0.3	75.0	25.0					25.0				
Tinned fruit	2.6	87.1	12.9	3.2				3.2				
Tinned vegetables	11.8	69.9	3.5	11.2				24.5	0.7	4.2	0.7	4.2
Frozen beef	1.7	71.4	9.5		4.8			57.1				
Frozen lamb	1.2	71.4			7.1		7.1	42.9	7.1			7.1
Frozen pork	3.5	78.6		2.4	4.8			52.4				
Frozen chicken	5.2	50.8		1.6	6.3			60.3	1.6		1.6	1.6
Frozen fish	5.7	49.3			1.4			59.4			1.4	1.4
Frozen shellfish	0.6	100.0						28.6				

Note: Multiple-response question

A major finding from the HCFPM about the location of food sources is that most purchases occurred within the respondents' neighbourhoods or within walking distance. Table 13 shows the locations of the outlets where households normally purchased various food items. Shaded cells demonstrate that more than 50% of households that purchased the food item made the purchase at this location. Blank cells indicate that no household purchased a certain food item at this loca-

tion. For example, 93% of households that purchased vegetables did so at an outlet located within their neighbourhoods or within walking distance. More than 80% of households purchased most food items within their neighbourhoods or within walking distance. More than 90% of households purchased the top three most commonly purchased food items (vegetables, fresh fruit, and fresh pork) within walking distance. This demonstrates a very spatially dense and evenly spread food supply network in Nanjing. The dense network of fresh food supply in Nanjing reflects one of the key advantages of China's urban food system.

TABLE 13: Food Purchases by Food Source Location

	% of households purchasing food	Percentage of households normally purchasing each food from a source at each location					
		Within my neighbourhood (in walking distance)	On road to or from work	Central Business District	Other shopping area	Outside the city	Other
Cooked pork	6.0	79.2	15.3		16.7		
Cooked beef	16.7	87.6	11.9	1.0	12.4		0.5
Cooked lamb	1.0	83.3	16.7				16.7
Cooked chicken	7.2	93.1	16.1	4.6	16.1		
Cooked fish	1.9	62.5	17.4	4.3	26.1		
Cooked shellfish	0.5	66.7	33.3	16.7	16.7		16.7
Pies, steamed buns with stuffing	47.9	88.5	5.4	0.6	10.4	1.8	2.7
Fresh or cooked vegetables	87.8	93.0	5.1	0.5	7.4	0.3	1.5
Fresh fruit	87.7	91.8	9.1	0.3	10.9	0.4	1.7
Fresh pork	85.9	92.1	5.0	0.2	9.5	0.4	0.3
Fresh beef	33.0	90.0	6.5	1.0	10.8	0.3	1.3
Fresh lamb	5.9	85.9	5.6	2.8	11.3		
Offal	15.0	91.2	5.5	1.1	7.7		
Fresh chicken	49.3	91.3	5.7		8.5	0.7	0.7
Fresh fish	71.7	90.8	4.3	0.3	8.9	0.3	1.2
Fresh shellfish	10.6	88.3	4.7		11.7		
Eggs	77.5	88.5	5.4	0.6	10.4	1.8	2.7
Fresh milk	59.6	73.2	4.3	1.0	13.2	0.8	16.0
Powdered milk, sour milk	46.7	83.0	4.1	0.4	14.0	1.1	6.0
White bread	28.9	81.4	12.6	2.3	20.3	0.9	1.4
Brown bread	20.9	83.4	13.8	4.0	17.0	1.2	
Steamed bread	58.2	93.2	5.4	0.1	6.0	0.4	0.9
Rice	79.3	86.8	4.9	0.7	14.0	1.8	4.1
Rice noodles	17.7	83.2	7.9	0.9	16.4	1.9	0.9
Chips	15.7	86.8	6.3	4.7	16.3	1.6	2.1

Sweets or chocolate	17.1	83.1	6.3	2.9	16.4	2.4	5.3
Snacks	43.1	87.2	8.2	2.1	19.5	1.3	4.0
Cooking oil	64.9	82.9	3.2	2.0	17.5	1.7	2.3
Sugar	40.9	88.5	2.0		11.3	0.6	1.6
Tea or coffee	27.8	78.6	1.5	2.1	16.1	3.6	8.0
Tinned meat	0.3	50.0	50.0				
Tinned fruit	2.6	71.0	12.9		12.9	3.2	6.5
Tinned vegetables	11.8	84.6	4.9		9.1	0.7	5.6
Pasta	71.5	89.1	5.0	0.8	11.7	0.5	1.0
Frozen pork	3.5	85.7	9.5		16.7		
Frozen beef	1.7	85.7	9.5	4.8	4.8		4.8
Frozen lamb	1.2	78.6	21.4		7.1		7.1
Frozen chicken	5.2	90.5	9.5		11.1	1.6	
Frozen fish	5.7	82.6	7.2	1.4	15.9		1.4
Frozen shellfish	0.6	71.4			42.9		
Note: Multiple-response question							

6.3 Perceptions of Supermarkets

Supermarkets have been rapidly expanding as a major food source in cities of developing countries, and China is no exception (Si et al 2016b). The survey asked respondents about their perceptions of shopping at supermarkets, with a different set of "agree/disagree" questions for supermarket patrons and non-patrons. The greater variety of foods and the accurate measurement compared to other food channels were the two most important reasons that people bought food at supermarkets in Nanjing (Figure 24). Respondents also agreed that food in supermarkets was cleaner and more hygienic, safer or of better quality. However, most did not agree that food in supermarkets was cheaper or fresher.

The reasons why non-patrons did not purchase food at supermarkets were more ambiguous. Respondents were divided between agreeing and disagreeing with most of the statements given about reasons not to shop at supermarkets (Figure 25). There was no statement with which half of the respondents agreed. Although the data suggest no consensus on the reasons for avoiding supermarkets, respondents generally disagreed that supermarkets were only for the wealthy, did not sell the food they needed or were too far away.

FIGURE 24: Perceptions of Supermarkets by Patrons

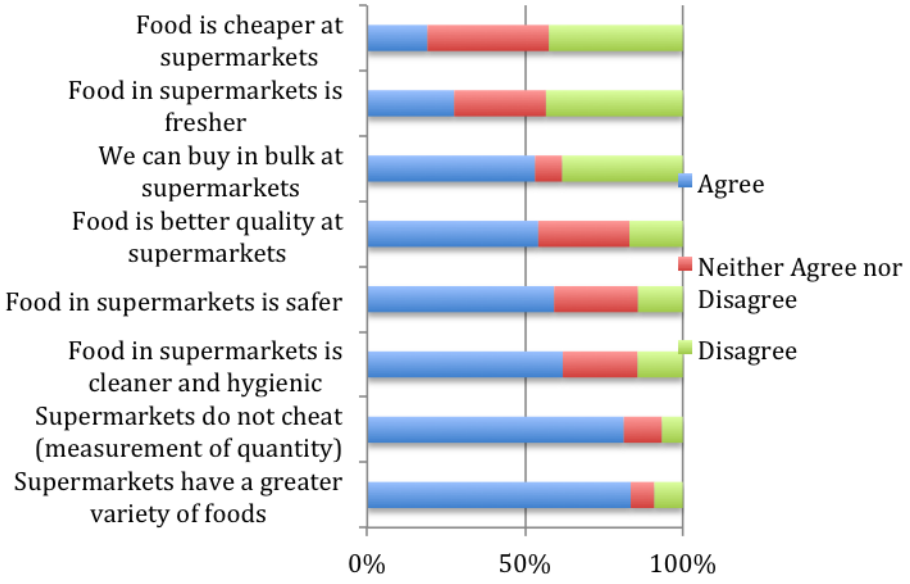
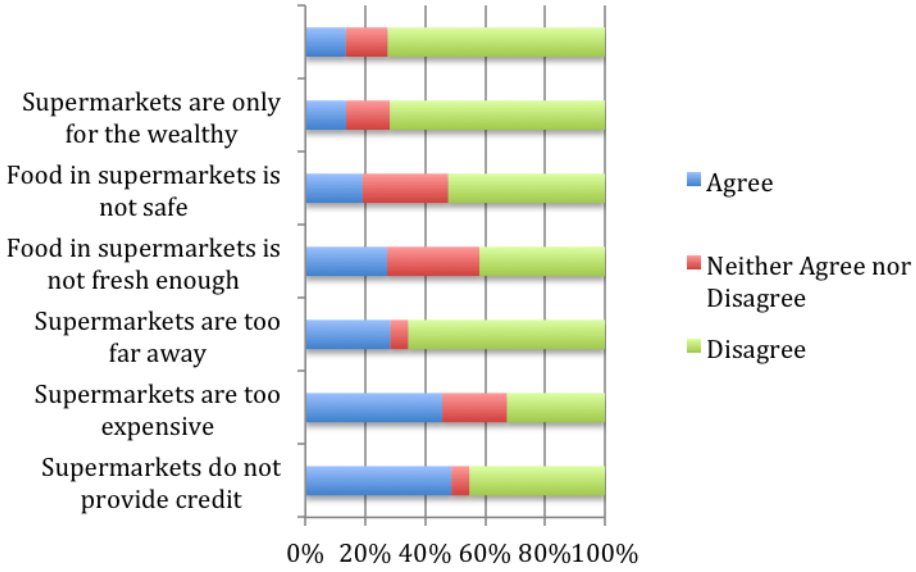


FIGURE 25: Perceptions of Supermarkets by Non-Patrons



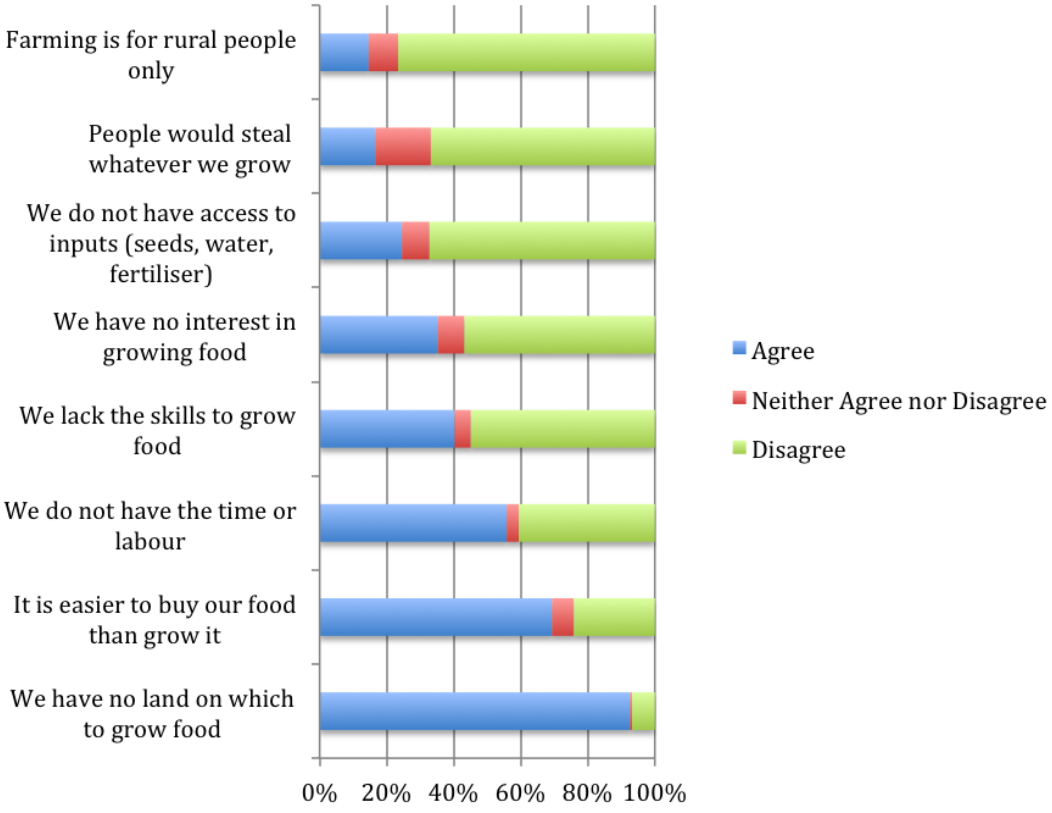
6.4 Urban Agriculture

Si et al (2016) note that Nanjing's urban core has very little land dedicated to urban agriculture. However, there are various attempts at growing food around residential buildings, especially in tiny front yards and on unused land. Balcony and rooftop gardening is found on a few buildings. Indeed, "Nanjing residents seem to use every available square inch in their communities to grow food" (Si et al 2016: 32). This survey provided the opportunity to assess the prevalence of

urban agriculture, to explore household perceptions of the practice and to delve into urban agricultural practices.

In total, only 21% of households produce some of their own food through urban agricultural activities, including growing food and raising animals. The majority of households in Nanjing therefore did not conduct urban agriculture. To understand why households did or did not practise urban agriculture, the survey asked respondents to agree or disagree with a series of statements about urban agriculture (Figure 26). Lack of access to land was the major factor prohibiting people from engaging in urban agriculture with 93% saying that this was a challenge. Over two-thirds (69%) noted that it was easier to buy food than to grow it. Lack of time and labour were also cited by 56% of respondents. Lack of access to inputs, fear of food theft, and the perception of farming being rural people's work were not inhibiting for the vast majority.

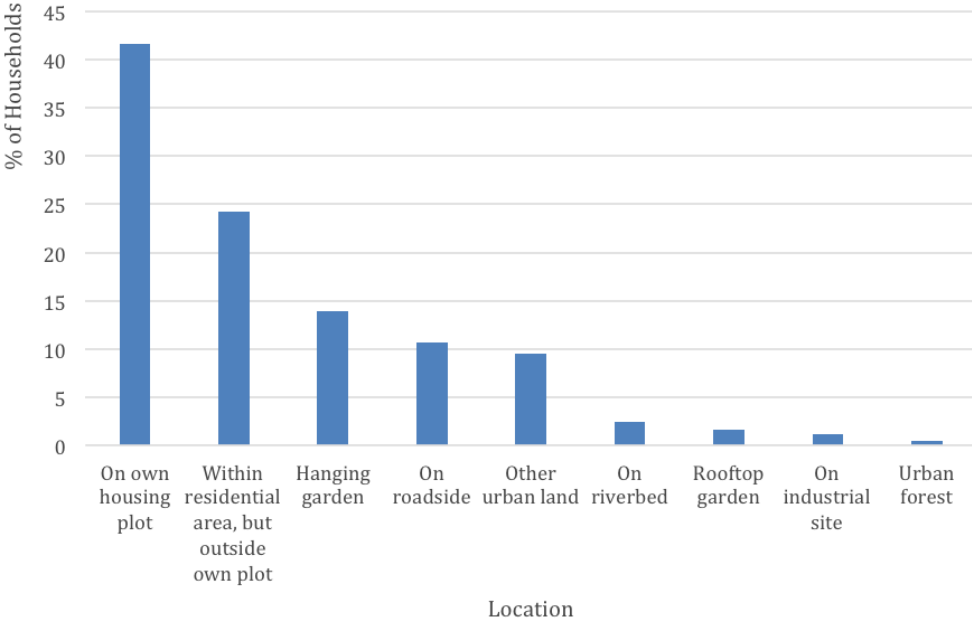
FIGURE 26: Reasons for Not Engaging in Urban Agriculture



Those who were producing some of their own food were asked an additional series of questions about their agricultural practices. They engage in urban agriculture at various locations with residential areas (including their own housing plots, residential areas outside their own plots, and balconies) being primary locations for urban agriculture. The most popular place to farm (42%) was on their

own housing plots. The percentage that farmed on residential areas outside their own plots was about 24%. There were actually very few households farming on riverbeds, rooftop gardens, industrial sites or in urban forests (Figure 27).

FIGURE 27: Location of Urban Agriculture Activity



The most common crop grown was vegetables (95% of those growing crops). Other crops included maize, wheat or rice (25%) and fruit (13%) (Figure 28). Only 6% of households were raising livestock for food and, of these, 96% were raising chickens (Figure 29). Other less common urban livestock rearing activities included raising pigs (11%) and cows (2%).

FIGURE 28: Urban Agriculture Crops

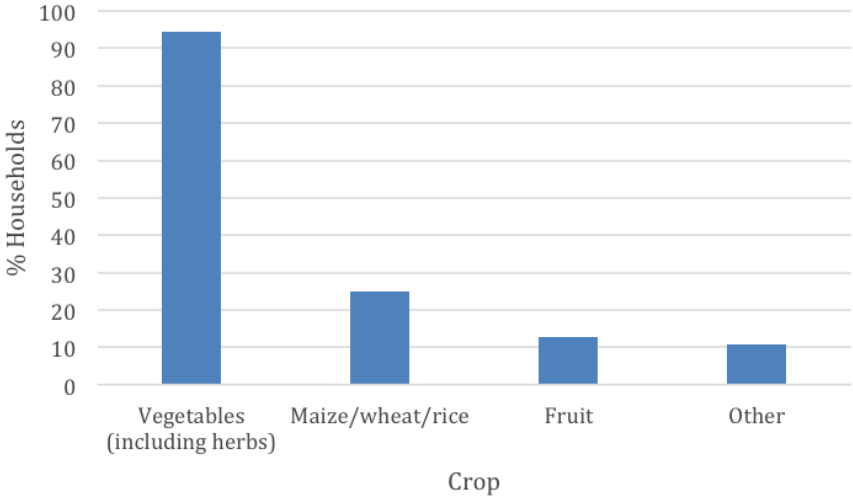
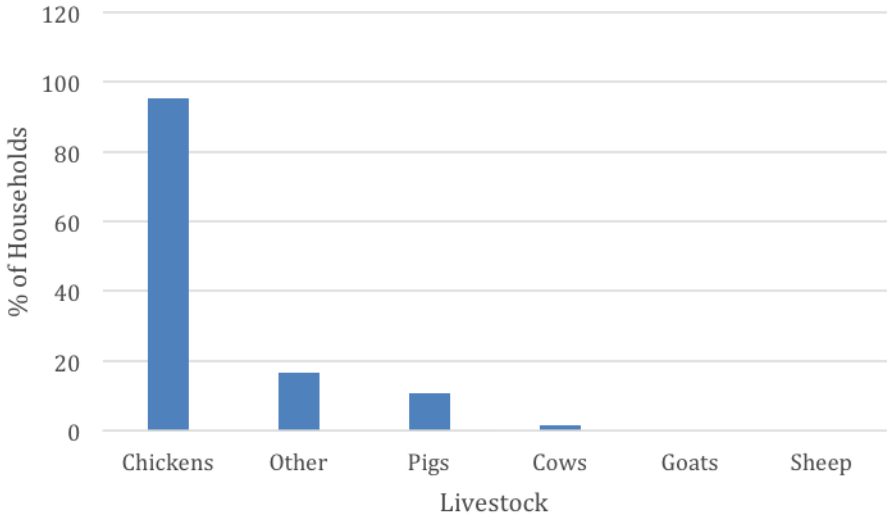


FIGURE 29: Urban Agriculture Livestock



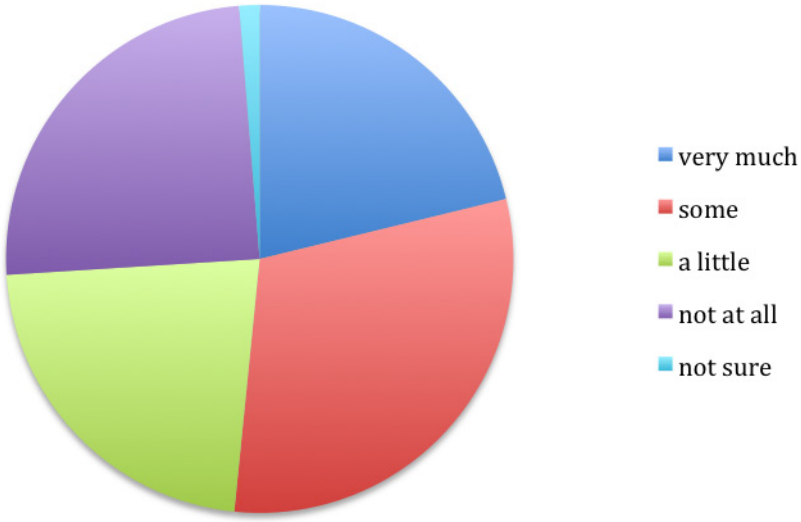
7. Food Safety

Recent definitions of food security have begun to incorporate the notion of food safety. In many Chinese cities, there is intense anxiety about food safety (Lam et al 2013, Wang et al 2015, Veeck et al 2015). This anxiety shapes people's daily food behaviours and affects their food security. To better understand how Nanjing residents perceive and cope with the food safety challenge, the survey included a section on food safety, with subsections on the severity and causes of the food safety problem, responsibility for food safety, the relative safety of various foods, and how food safety concerns shape how people access and prepare food.

7.1 Food Safety Environment

Nanjing residents are clearly concerned about food safety, with three-quarters of respondents saying that they worried about food safety on a daily basis (Figure 30). In terms of the degree of concern, 21% "worried very much" that they and their households might not be able to get safe food to eat every day, while 30% were "somewhat worried", and 22% of respondents were "a little worried". Only 24% of respondents were "not worried at all". This high level of anxiety reveals not only the pressing food safety environment that is directly felt by most households, but potentially also the inability of households to acquire safe food continuously or to ensure the safety of the food that they consume. This includes either a lack of access to food supply channels for safe food, monetary resources or trustworthy information.

FIGURE 30: Perceptions of Food Safety Problems



The survey asked respondents to choose the three most serious food safety problems from a list of 12 problems. Table 14 demonstrates that food production methods are a major source of worry. The top concerns were about pesticide and herbicide residue in fresh vegetables (56%) and hormone and antibiotic residues in meat (46%). Illegal food additives in processed food were also considered a serious problem by 45% of respondents, probably due to the various food safety scandals covered by the media that have involved illegal additives. The use of gutter oil in food preparation was an even higher concern than food adulteration, which reflects the influence of specific high-profile food safety incidents on people's perceptions. Practices that lead to "poisonous food" such as illegal food additives and food adulteration were more urgent concerns than substandard hygiene in food handling and bacteria in food. Although genetically modified food ranked low in the survey, the presence of genetically modified organisms in the food system was a significant part of the qualitative discussions throughout our interviews, particularly because of the intense debates in China over genetically modified food.

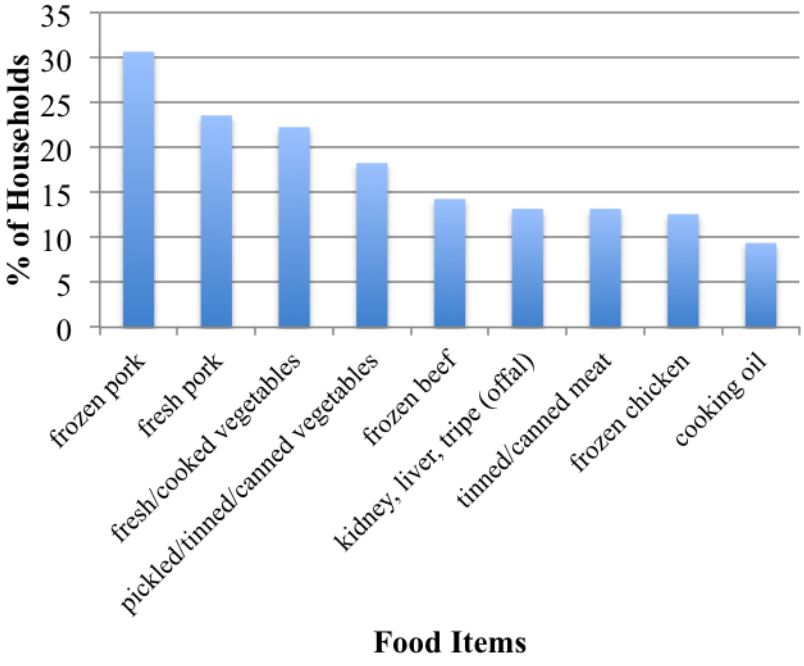
Figure 31 shows the food items perceived to be the most unsafe. Pork and vegetables, as the most commonly consumed foods in China, occupy the top spots on the list, followed by other types of meat and cooking oil. In general, people were more concerned about the safety of meat, vegetables, and cooking oil than other foods such as noodles, rice, eggs, and dairy products.

TABLE 14: Perceptions of Food Safety Problems

	No. of respondents identifying problem	%
Pesticide and herbicide residues in fresh produce	652	55.7
Hormone and antibiotic residues in meat	534	45.6
Illegal food additives in processed food	523	44.7
Hormone residues in fresh produce	303	25.9
Use of gutter oil*	277	23.7
Food adulteration (fake rice, fake eggs, etc.)	225	19.2
Substandard hygienic conditions of production and/or processing	204	17.4
Bacteria in food	174	14.9
Contamination of heavy metal and other chemicals from the soil	159	13.6
Genetically modified food	120	10.2
Water contamination	108	9.2
Excessive use of synthetic fertilizer	83	7.1
Other (please specify)	65	5.5

** Note: Gutter oil refers to recycled cooking oil from food waste from restaurants, sewer drains, grease traps, and abattoir waste.*

FIGURE 31: Foods Perceived to be the Most Unsafe



7.2 Causes and Responsibilities for Food Safety

Chinese consumers often blame small producers and the government for the worsening food safety conditions but overlook the role of structural changes in the food economy (Veeck et al 2008). The top three contributing factors identified in the survey confirm this observation; they are all associated with the lack of enforcement of existing regulations. The low integrity of food processors and producers is also considered a major cause of food safety problems.

Structural problems and social changes associated with food safety were generally viewed as less important. For example, the "rapid decline of social trust" was perceived by only 8% of respondents as an important cause. Causes associated directly with consumers such as consumer preference and the disconnection between consumers and food also received relatively little attention. Low food prices, which encourage producers and processors to use illegal methods for profits, also received less votes. Other causes mentioned by survey respondents include corruption, deficiencies in laws, environmental pollution, and false media reports.

TABLE 15: Perceived Causes of Food Safety Problems

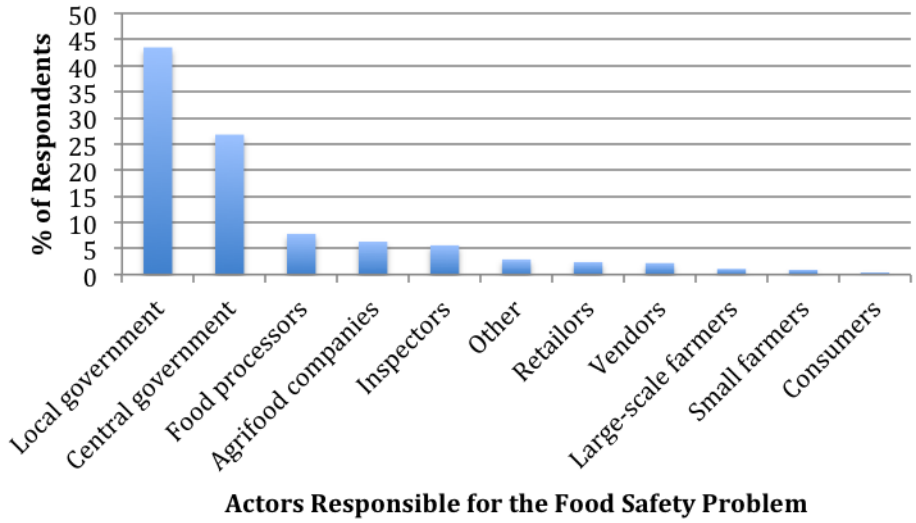
Causes	No. of respondents identifying cause	%
Government has not enforced food safety regulations effectively	756	64.8
Punishments for violators of food safety laws/ regulations are not strict enough	680	58.3
There are too many small producers and/or processors to monitor	460	39.5
Low suzhi (integrity) of food processors	455	39.0
Inspectors are not performing their duties	342	29.3
Low suzhi (integrity) of food producers	285	24.4
Consumers' preferences (appearance, lean meat, blemish free, etc.) encourage illegal use of chemicals	98	8.4
General lack of trust in our society	97	8.3
Price of food is too low, which encourages producers/ processors to use illegal methods to cut their costs	90	7.7
Consumers have no control of, or know too little about, their food	61	5.2
Other	47	4.0

In terms of who should be the most responsible for addressing food safety problems, 70% believed that the government should be the most responsible stakeholder (44% said the local government and 26% the central government) (Figure 32). While the central government (always seen in the Chinese context as a combined entity comprising the State Council, ministries and agencies at the ministry level, and the National People's Congress) is responsible for legis-

lation and supervising local government, local governments are responsible for the enforcement of laws and regulations and monitoring food safety problems. The fact that local governments were considered to be more responsible than the central government suggests that most people believe that the enforcement of laws and regulations and the monitoring process are bigger problems than the legislation itself.

Food processors rank third on the list of stakeholders responsible for addressing food safety problems. This corresponds with the significantly high level of concern about "illegal additives in processed food" (Figure 32). All food handlers along the food supply chain were considered responsible to various extents for food safety problems. Yet farmers, regardless of size, were considered less responsible than agrifood companies and others along the food value chain. However, it is unclear whether this means that Nanjing residents actually blame agrifood companies for food hazards associated with fresh produce and meat.

FIGURE 32: Perceptions of Responsibilities for Addressing Food Safety Problems



7.3 Coping Strategies for Addressing Food Safety Problems

Klein (2013) notes various food safety strategies by residents of Kunming, the capital of Yunnan province. Similarly, residents of Nanjing employ various strategies during both food access and food preparation processes to determine the safety, freshness and authenticity of food purchased and thereby reduce the risk to their health (Table 16). The survey found that consumers trust certain retailers and brands. More than 50% would seek alternative food sources, such as buying more local food or buying directly from farmers they trust.

There are three ecological labels for food in China: organic, green food, and hazard-free food. Organic food, despite having the most stringent level of requirements, was less widely consumed as a response to food safety concerns than the other labels, although all were in the similar range of 40% to 48% (Table 16). This finding suggests a lack of knowledge about the certifications and the most easily assumed safety characteristic from the word "green" when there was a lack of other information. The survey also revealed that 19.6% of respondents grew their own food, which suggests a modest level of engagement in urban agriculture in Nanjing as a response to food safety risks.

TABLE 16: Coping Strategies to Mitigate Food Safety Risks

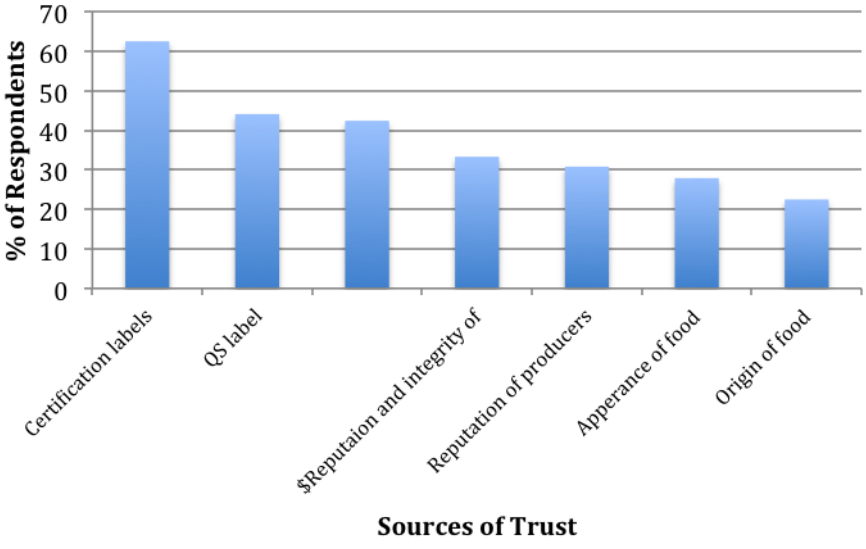
Categories		Strategies	No.	%
Food access	Safety	Avoid food with too "perfect" an appearance	658	58.1
		Intentionally buy vegetables with insect holes	383	33.8
	Freshness	Buy more local food	655	57.9
	Authenticity	Read nutrition labels and/or ingredients when I buy packaged food	786	68.7
		Buy certain brands of food	619	54.1
		Buy food that is traceable	215	19.5
	Selection of food sources	Only buy certain types of food from certain outlets	653	57.1
		Get food directly from farmers I trust	628	54.7
		Change the place where I buy certain types of food due to food safety concerns	558	48.7
		Get food directly from my rural relatives	469	40.6
		Buy food through the internet	116	10.1
	Selection of labelled food	Buy certified green food	531	47.5
		Buy certified hazard-free food	521	46.8
		Buy certified organic food	448	40.1
	Other	Ask sellers questions to inspect food quality	666	58.2
		Check the origin of the food	598	52.3
		Follow instructions of experts to determine what to eat	490	43.1
		Grow my own food	229	19.6
Food preparation	Soak fresh produce/fruits in water before using it to remove chemical residues		916	79.8
	Soak fresh produce/fruits in water before using it to kill bacteria		762	67.3
	Wash fresh produce/fruits with rice water to remove chemical residues		479	41.7
	Wash fresh produce/fruits with salt or other cleaner to remove chemical residues		412	35.7
	Wash fresh produce/fruits with rice water to kill bacteria		371	32.6
	Wash fresh produce/fruits with salt or other cleaner to kill bacteria		374	32.5
Other			77	6.8

In terms of food preparation strategies, soaking fresh produce and fruit in water were the most common strategies, while rice water, salt and other cleansers were also commonly used to treat food before cooking. Interestingly, removing chemical residues was more of a concern than killing bacteria. This indicates a shifting focus from food hygiene towards the more complicated food safety issue in China (Yan 2015). Strategies other than those in the questionnaire include blanching, boiling food before cooking, washing fruits and vegetables with disinfectants, baking soda or flour, using various machines (e.g. vegetable washer, ozone machine) to treat food, peeling fruits and vegetables, making their own cooking oil (in response to the threats of "gutter oil"), and reducing their purchases of processed food.

7.4 Sources of Trust

There are several potential ways that consumers could gain more trust in the safety of their food, including certification labels, the Quality and Safety (QS) label, brands, the appearance and provenance of food, as well as the reputation and integrity of producers and retailers. Although food safety scandals severely reduced consumer confidence in the formal institutionalized quality assurance system, certifications and QS labels are still convenient sources of trust for consumers (Figure 33). Nearly two-thirds of the respondents (63%) reported that certification labels made them more confident in the safety of food, followed by QS labels (44%) and brands (42%). By contrast, only 23% believed that the provenance of food would make it trustworthy in terms of safety. Reputation and integrity of retailers (33%) and producers (31%), and the appearance of food (28%) had slightly more influence on people's perceptions of the safety of food products.

FIGURE 33: Sources of Trust in Food



8. Conclusion

The centrality of wet markets and supermarkets to food retail and food procurement by households across Nanjing emerges clearly in this survey. The relationship between wet markets and supermarkets appears to be more complementary than competitive. However, the actual organization and functioning of these critical players in the city's food chain is not well understood. Nor are the broader local, regional and international supply chains that link these outlets to suppliers and producers. Informal food vending is much less important than in other cities in the Hungry Cities Partnership but is not non-existent. The survey also identified the growing importance of online food vending. Reardon et al (2012) have identified the existence of a "quiet revolution" in Chinese food supply chains in recent decades. Exactly how the revolution is playing itself out in Nanjing and how it relates to the city's complex food retail system requires further research. The opportunities offered by a transforming food system to women and youth also need particular attention. The next phase of HCP research in Nanjing will therefore build on this report by examining the functioning and role of wet markets and small-scale formal and informal food vendors in the city's food system.

Nanjing Officials at HCP Knowledge Mobilization Workshop, Nanjing, January 2017

Prof. Jonathan Crush Discusses the Hungry Cities Partnership with Nanjing Officials and Nanjing University Faculty and Students

Dr Zhenzhong Si Presents the Household Survey Results to Nanjing Officials

Endnote

1. The conversion is based on the monthly currency conversion rate in June 2015, the month before the survey was conducted. In June 2015, CNY1 equalled USD0.161002, according to the data from X-Rates (http://www.x-rates.com/). The same conversion rate is used throughout the report unless specified otherwise.

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This report on the state of food security in Nanjing, China, is based on a 2015 city-wide survey conducted by Nanjing University and the Hungry Cities Partnership. The research found that most of the city's residents are food secure, with access to desirable foods and high dietary diversity throughout the year. Nanjing has a high level of economic development, low unemployment, and spatially dense food supply networks. However, a high average level of food security obscures the finding that about one household in five is food insecure according to the Household Food Insecurity Access Prevalence indicator. Female-centred households, households that have no formal wage worker, and households with only one member tend to be the most food insecure. The proximity of wet markets and supermarkets to food retail and food procurement by households across Nanjing emerges clearly in this survey, and the relationship between wet markets and supermarkets appears to be more complementary than competitive. The survey found that three in four respondents feel exposed to threats of unsafe food from the production and processing stages of food supply chains, especially from the overuse of agrochemicals in the agriculture and livestock industry. There is a widespread perception that the ineffective enforcement of regulations by local governments is the major cause of food safety problems.