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Decision tree analysis of the prospects of organic food: Evidence from China and Hungary

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Abstract: With the growing population, increasing income, and high-speed lifestyle, people pay more attention to a healthy diet and nutritional food. Organic food, also regarded as healthy, sustainable, or eco-friendly eating, has gained global popularity. This trend has been particularly amplified by the COVID-19 pandemic, leading to a surge in demand for nutritious foods worldwide. Organic food originated in Europe, with the highest development globally. Its progress varies by country. China's organic food industry began decades ago, growing rapidly. As globalisation advances and China's economy accelerates, it is valuable to examine the organic food industries in Hungary and China. In order to understand the willingness of consumers to buy organic food, we conducted a survey for a month in 2021 from 581 respondents in Hungary (185), China (374), and other countries, compared the respondents' demographic data, organic food consumption and their buying willingness and attitude to recommend organic food to other consumers. The decision tree analysis was deployed to analyse the statistical data via SPSS software. It showed that organic food has a positive demand in both Hungary and China, but some purchase habits are different in these two countries.

Keywords: consuming behaviours; green food; COVID-19; sustainability

Food remains a pivotal topic for both markets and consumers, with evolving demands and shifting purchasing habits over time. Increased health awareness, higher buying power, and intensified work routines have made a healthy lifestyle, particularly through diet, a central topic of interest (Popovics 2024). Organic foods represent a leading green product, with organic farming hailed as a sustainable agricultural management system (FAO 2014; Kowalska et al. 2021). Organic agriculture improves the efficiency of land and labour compared to conventional agriculture (Baer-Nawrocka and Błocisz 2018). It strictly prohibits genetically modified organisms and antibiotics. For consumers, choosing organic food aligns with values related to health, animal welfare, and environmental care (Shafie and Rennie 2012). Initially, due to middle-class behaviour, organic food demand has surged, particularly following the COVID-19 pandemic.

Understanding the future direction of organic food and related consumer behaviour is crucial for developing this market sector. Most studies on organic food consumption are region-specific, limiting comparative insights across nations with diverse market maturity levels. Cross-country comparisons can reveal unique consumer behaviours and determinants – such as knowledge and health consciousness (Pacho and Batra 2021) that influence organic market potential (Grzelak and Maciejczak 2013). Research validated across multiple countries enhances insights into such behaviours (Steenkamp and Baumgartner 1998). This study

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focused on two distinct countries – Hungary and China – representing different stages of organic food adoption. Despite the differing stages of development in Hungary and China, both countries share a promising outlook for the organic food market. Hungary, with its population of 9.6 million and strong organic food practices, shows promising market growth prospects. Meanwhile, China, with its 1.4 billion population, displays a less mature but rapidly expanding organic food sector supported by economic growth and ample fertile land (Shafie and Rennie 2012; World Bank 2020).

This study aims to assess and compare the organic food market landscape and consumer behaviours in Hungary and China. We structured our research in two stages: a literature review examining the shifts in food demand (quantity and quality), industry status in China, Hungary, and Europe, followed by primary research assessing Chinese and Hungarian consumers' willingness to buy organic products, recognising that consumer demand is the primary driver for this market (Szente et al. 2007).

Shifts in food demand (quantity and quality). A sufficient and nutritious diet is a fundamental component of national safety and security. Hunger and malnutrition can arise from numerous factors, including high food prices, persistent natural disasters, conflict, population growth, poverty (Prosekov and Ivanova 2018), limited natural resources (such as arable land and water), and climate change. Population growth is expected to drive a 59% to 98% increase in food demand from 2005 to 2050, with the global population projected to reach 9.1 billion by 2050 (UN 2005). Research has demonstrated that food security may be compromised by various elements, including globalisation, demographic and security challenges, natural hazards, health resource constraints, international governance systems, environmental issues, biodiversity loss (linked to climate change or extreme weather events), and the security of energy and infrastructure (Wu et al. 2023). Additionally, factors such as future agricultural production and demand, challenges in implementing digital agriculture, security issues in Agriculture 4.0, market fluctuations, and ongoing food security concerns (including food loss and waste) further exacerbate the crisis in food security. Temporary issues, like the COVID-19 pandemic and the Russia–Ukraine conflict, have also contributed to recent food security crises.

Beyond the rising demand for food quantity, there is also a noticeable shift toward higher food quality (Pilař et al. 2018; Beranová et al. 2020). As population numbers and incomes increase (FAO 2018) and fast-paced lifestyles become more prevalent, dietary habits are evolving, with a growing trend toward healthier and more environmentally sustainable diets (Varga and Csiszárik-Kocsir 2024). The COVID-19 pandemic has further heightened awareness around healthy eating. In examining major global crises, including the 2002–2004 SARS outbreak, the 2011 Christchurch earthquake, the 2017 Hurricane Irma, and the COVID-19 pandemic in China, it is evident that such events negatively impact global economies. Of these, COVID-19 has been particularly disruptive, notably altering consumer purchasing behaviours (Djokoto and Pomeyie 2018; Loxton et al. 2020). During the pandemic, people increasingly opted to cook at home, prioritised staple foods and favoured small local retailers and online shopping. A survey of 5 000 consumers across Australia, China, India, Indonesia, Japan, South Korea, and Thailand revealed that over 75% of respondents were more focused on health, aiming to improve their well-being through exercise and healthier eating. Despite price fluctuations and concerns about future income, consumers appear inclined to purchase more nutritious and sustainable foods (Borsellino et al. 2020).

The state of the Hungarian and Chinese organic food market. The organic food market in Hungary was established in 1980, with official documentation of organic and transitioning farmland beginning in 1996 (Szente et al. 2007). Hungary's organic sector primarily comprises arable crops, perennial crops, and vegetables, with limited emphasis on organic animal husbandry (Drexler and Dezseny 2013). Across Europe, the organic livestock industry is expanding rapidly (Willer and Lernoud 2019). The most popular organic products in Hungary are staple foods like milk, dairy products, bakery items, vegetables, and fruits. However, high prices are a significant barrier to purchasing these products, and there remains a general distrust towards organic labels. Despite this, Balázs (2012) observed that, since 2010, Hungarian consumers have shown a growing interest in local and organic food, evidenced by the development of local food systems. This trend has stimulated further research by various academic groups and institutions, and there has been a notable increase in the number of organic farmers in Hungary due to the expanding market (Benedek and Balázs 2016).

Research indicates that health consciousness, environmental concerns, ethical awareness, and sustainable lifestyles drive organic food purchases more than product price, appearance, or brand (Nagy-Pércsi and Fogarassy 2019). However, a 2015 survey found that for Hungarian consumers, price is the primary factor

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influencing organic food purchases, followed by food quality and health benefits (Szente and Torma 2015). This study highlighted a potential market demand for organic food in Hungary. According to recent data from Statistics.FiBL.org (FiBL 2020), organic farmland, agricultural land share, the number of organic producers, and retail sales are growing across Europe, reflecting a similar trend in Hungary. Willer and Lernoud (2019) also noted that European demand for organic food is rising faster than the supply, driven by a shift toward healthier lifestyles. As of 2017, Hungary reported 199 684 hectares of organic farmland, accounting for 4.3% of its total farmland, with an additional 95 200 hectares converted that year, positioning Hungary as a leader in organic land conversion.

It was claimed that the organic market in China is growing due to rapid social and economic development and changing consumption patterns (Ye et al. 2019). While there has been an increase in organic entrepreneurship, the market is primarily concentrated in the southern and southeastern regions of China, including Nanjing and Shanghai. Unlike European organic consumers, who prioritise food safety and health, Chinese organic consumers are mainly influenced by price and income when making purchasing decisions (Li et al. 2019). China's organic farms are small, averaging 0.5 hectares. The government partners with companies to enforce strict organic standards, ensuring food safety and traceability, driving the development of organic farming.

China's organic market, though small, is growing. Between 2007 and 2013, retail sales surged from EUR 365 million to EUR 2 430 million, supported by e-commerce. However, organic farmland growth has been inconsistent, reaching 1.6 million hectares in 2017. The number of organic producers peaked in 2015 and then declined to 6 308 by 2019 (FiBL 2020).

MATERIAL AND METHODS

This research explores the future of organic food in Hungary and China, both showing promising potential. The current state of organic food was analysed using secondary data and surveys. Our primary research involved demographic data collection (age, education level, occupation, gender) and consumer behaviours, such as purchase motivations and barriers, factors influencing organic food choices (income, dietary habits, expenditure, purchase frequency), effective marketing tools, and willingness to recommend organic products. Primary data from young workers and students were collected in 2021 through online questionnaires in Hungarian and Chinese. Using decision tree analysis, we explored differences in buying motivation between China and Hungary, offering insights for current and future industry stakeholders.

Survey design and investigation technique. Hungary's population of 9.769 million shows growing interest in organic food, especially in urban areas. China, with 1.398 billion people, has a developing organic market focused in large cities, showing strong growth potential. All participants had the opportunity to review and edit their responses to the specific questions. A pre-test of the questionnaire was conducted to identify any potential errors or unreliable information. Once all the authors confirmed the reliability and validity of the questions, the online questionnaire was distributed to the participants. The questionnaire was developed based on reliable literature (An and Kang 2006; Nagy-Pércsi and Fogarassy 2019; Pangaribuan et al. 2020). A 14-question survey assessed consumer willingness and habits regarding organic food, with 581 respondents (374 from China, 185 from Hungary). Though not fully representative, the data provide insights into consumer preferences. Data were collected from 581 respondents on demographics, spending, and decision-making. Though the sample is not representative, it forms a solid basis for analysis.

Analytical techniques. Based on secondary data, we analysed the trends in organic production and consumption using statistical data from both China and Hungary and collected the data from the professional Chinese questionnaire website 'Wen Juan Xing'. When creating the questionnaire, we referred to some literature (An and Kang 2006; Nagy-Pércsi and Fogarassy 2019) as a basis. After collecting the primary data, descriptive statistics were used for the analysis of the samples using SPSS 26 software. The demographic data were analysed and summarised in terms of frequency and percentage. Decision tree analysis was used to clarify the most significant differences between the consumers' consumption habits on organic food. The Exhaustive CHAID method was used as a growing method (Gunduz and Lutfi 2021). Cross-validation was used and the number of sample folds set to 10. The minimum number of cases in the parent node and child node are 30 and 10. The maximum tree depth is 6.

Cluster analysis was unsuitable due to similar respondent characteristics, so a decision tree method

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was used to better segment the data. The decision tree served as a segmentation tool (Mai and Tick 2021), providing a visual representation of the key questions.

Hypotheses. So far, all of our hypotheses have been justified. The hypotheses are summarised below:

H_1: There is a significant attitude difference between Chinese and Hungarian respondents in organic food from the perspective of buying willingness and recommendation attitude.

H_2: The most significant difference between Chinese and Hungarian respondents in buying organic food is buying frequency.

H_3: Food habits (vegetarian and non-vegetarian) have an influence on organic food attitudes.

RESULTS AND DISCUSSION

The study found differences in organic food attitudes between Hungarian and Chinese consumers, confirming the relevance of further analysis.

Demographic analysis. Among the 559 valid responses, 55.6% were male, most aged 21–30, with bachelor's or master's degrees. Income levels varied, with 39.9% earning less than EUR 300 per month, and 25.6% earning over EUR 700. These features showed the same in Chinese and Hungarian respondents separately (Table 1).

Attitude to organic food consumption. Firstly, we did two decision tree analyses for all the responses, and we set 'willingness to buy organic food' and 'recommendation attitude' to the dependent variable separately, and the independent variables are demographics to see what impacts the willingness to buy the most and the recommendation attitude. The most significant difference of 'buying willingness' (Figure 1) and 'recommendation attitude' (Figure 2) separately share the same answer, country, which means there is a significant attitude difference between Chinese and Hungarian respondents in organic food purchase attitude from the perspective

Table 1. Demographic statistics of respondents from China and Hungary

Personal profile	Category	China (%)	Hungary (%)
Age	≤ 20	4.81	9.73
	21–30	62.30	77.84
	31–40	4.28	7.57
	41–50	20.50	3.24
	> 50	8.56	1.62
Gender	female	36.10	41.08
	male	62.83	57.84
	prefer not to say	1.07	1.08
Education	secondary school	2.67	1.62
	high school	5.61	11.89
	college	9.89	7.57
	bachelor's degree	48.13	30.27
	master's degree	29.41	40.54
	Ph.D./higher degree	4.28	8.11
Occupation	student	45.45	74.59
	employed	40.37	9.73
	unemployed	3.48	2.70
	self-employed	4.01	5.41
	working while studying	3.21	6.49
	retired	3.48	1.08
Monthly income (EUR)	< 300	43.58	32.43
	301–500	15.51	21.08
	501–700	14.71	22.16
	> 700	26.20	24.32

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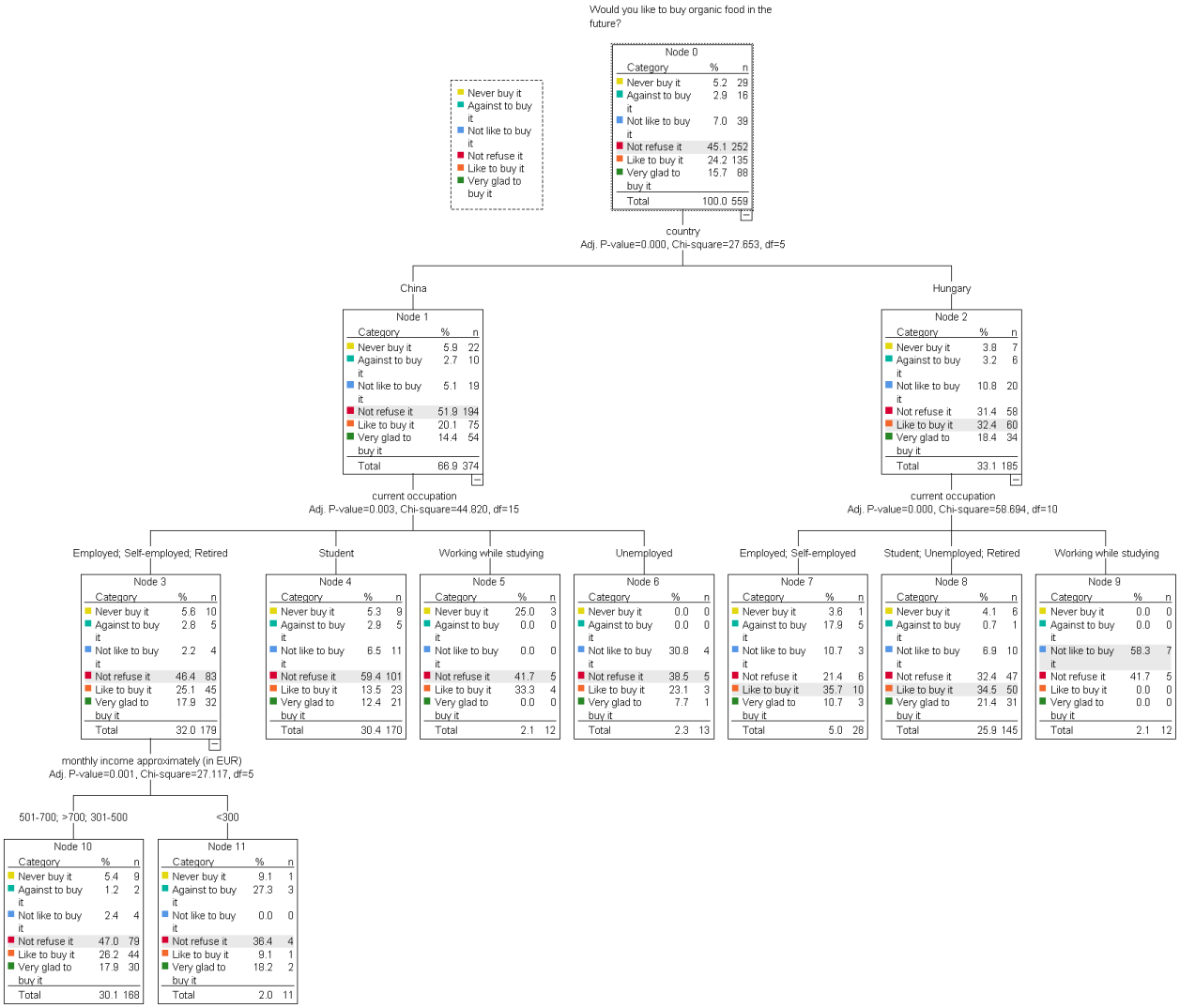

Figure 1. Buying organic food willingness for all respondents (developed by authors)

of buying willingness (P = 0.000) and recommendation attitude (P = 0.000). This result from the Exhaustive CHAID method test and Chi-Square is 27.653 (Figure 1) and 27.765 (Figure 2).

A comparative analysis of consumer attitudes revealed that Hungarian respondents generally exhibit a more positive inclination towards organic food purchases than Chinese respondents. Significant differences were noted in occupation (China: P = 0.003; Hungary: P = 0.000) and income (P = 0.001), indicating the importance of further investigation into how these demographic factors affect organic food purchasing behaviours in each country. Survey responses revealed that most consumers display a cautious attitude when recommending organic food to others, often indicating they are 'not sure'. The decision tree analysis concluded at the initial level for Hungarian respondents and extended to the third level for Chinese respondents. For Chinese consumers, attitudes toward education and gender exhibited a 'not sure' response across various levels, suggesting that these factors do not significantly influence organic food purchase behaviours.

Additionally, no substantial differences were found in food habits (e.g. vegetarian vs. non-vegetarian) concerning organic food purchase willingness and recommendation attitudes. Therefore, our further analysis continues with the initial result: There is a significant attitude difference between Chinese and Hungarian respondents in organic food from the perspective of buying willingness and recommendation attitude (H_1).

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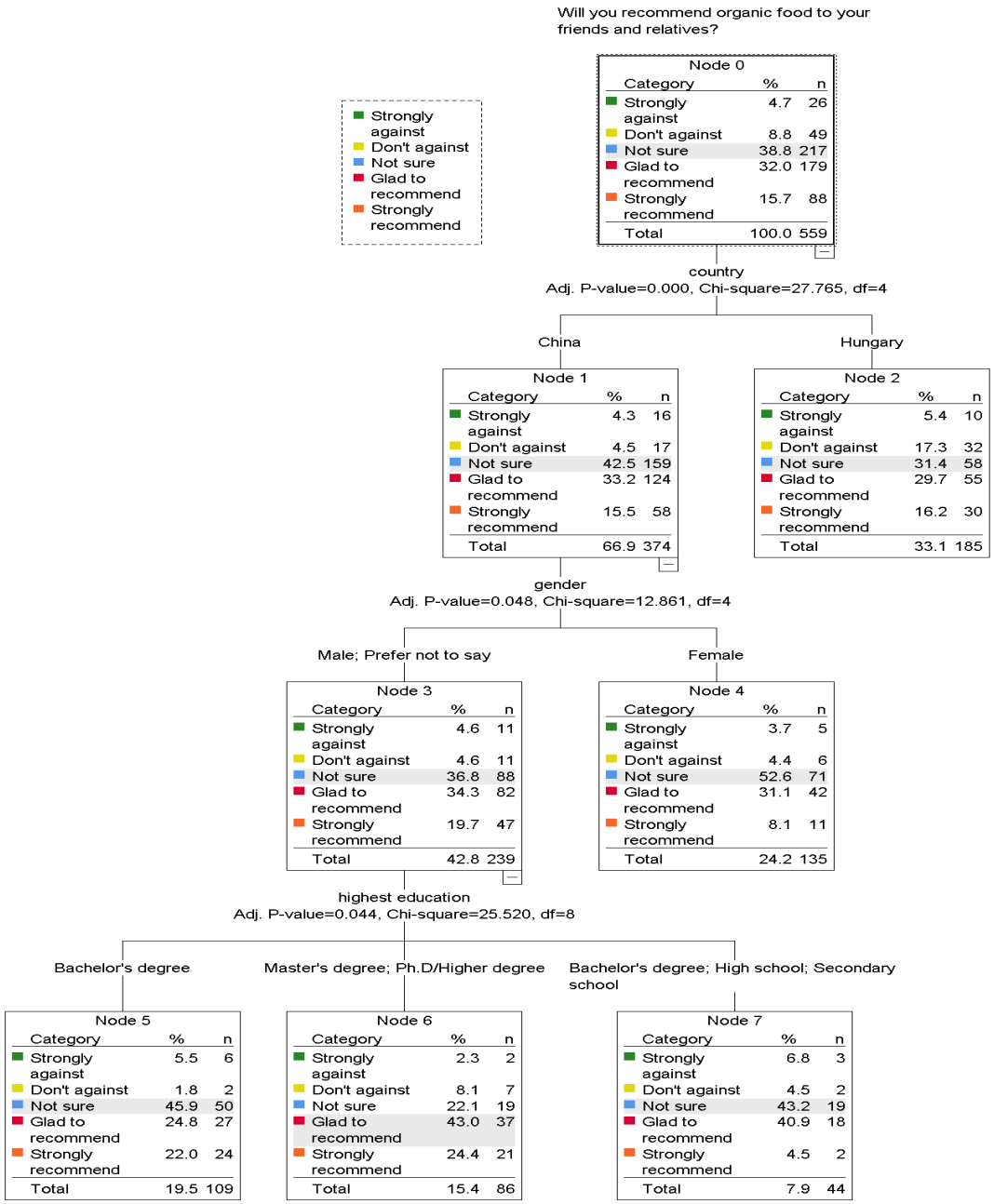

Figure 2. Recommendation attitude to organic food for all respondents (developed by authors)

The organic food attitude difference between Chinese and Hungarian respondents. The most significant difference between Chinese and Hungarian respondents in organic food purchase is the frequency of buying organic food (Figure 3, P = 0.000). There is no significant difference between these two countries' respondents in their willingness to buy and recommend it to other people in this decision tree. However, most of the nodes show that Chinese respondents make up a higher percentage than Hungarians due to the sampling number. The Hungarian respondents only show a higher percentage than the Chinese on the high price (0.007) rejection reason for buying organic food and the same percentage on not buying organic vegetables (P = 0.027). In order to keep the reliability of the sampling data, 374 respondents were from China, and 185 respondents were from Hungary, which indicates that the original number gap is big. The Hungarians in the decision tree mostly show lower percentages than the Chinese.

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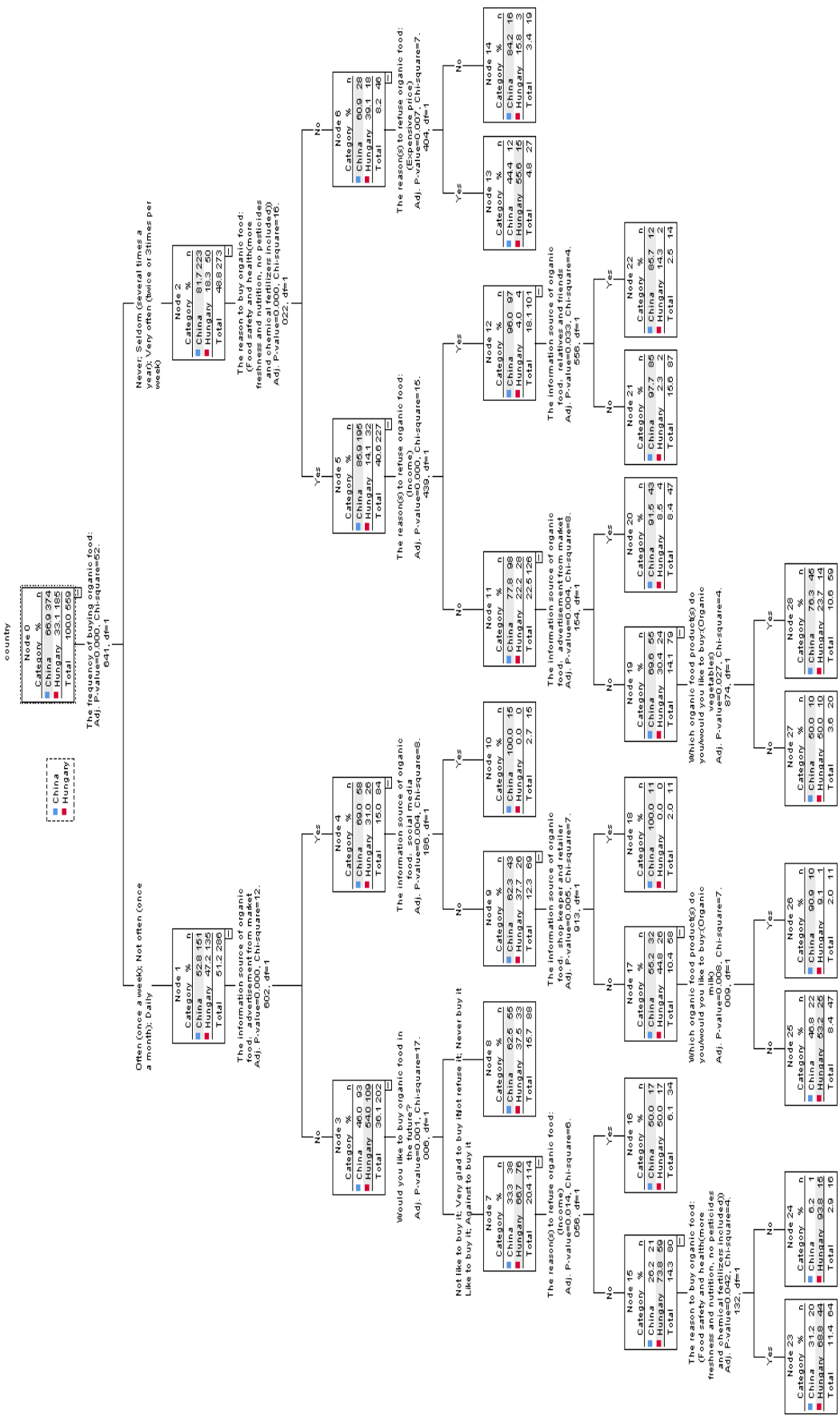

Figure 3. Tree diagram of respondents' purchase behaviour on organic food among Chinese and Hungarian (developed by authors)

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We compared the data vertically according to the tree level by level instead of always comparing them to China in one node. The decision tree analysis is described in details as below:

Level 1 (P = 0.000): 223 out of 374 Chinese respondents do not often buy organic food. Most of Hungarians (47.2%) often buy organic food.

Level 2: The reason for the most of those, who less often (P = 0.000) buy organic food is that they think organic food is safe and healthy (40.6% and 8.2%). But Hungarian's opinion on this item is lighter than that of Chinese because 39.1% of them do not think so, and only 14.1% agreed that they buy organic food because it is safe and healthy.

Level 3: Hungarians do not refuse to buy organic food because of their income (P = 0.000) and income does not show a significant difference for Chinese on the response option of 'refuse it' (98 yes and 97 no). But Hungarians refuse to buy it because of its high price (P = 0.007). It also shows that Chinese do not really care about price.

Level 4: Both Chinese and Hungarians do not really get information about organic food via advertisements from the market (P = 0.004). Obviously Chinese get more influence from relatives and friends on organic food (P = 0.033). But Hungarians have the same number of agree and disagree with this term.

Level 5: Both Chinese and Hungarians prefer to buy organic vegetables (P = 0.027).

The Exclusive CHAID algorithm reduces the decision uncertainty from 33.1% to 12.16% by level 5 [(20+1+22+1+10+14)/559 = 0.1216], which is a 20.94% (33.1%-12.16% = 20.94%) reduction in uncertainty (i.e. error) compared to level 0. There was a 25.22% probability of misclassification, meaning that classification is 74.78% accurate. It concluded that Chinese and Hungarian respondents share similar attitudes about organic food, but their current buying behaviour is different. Hungarians buy organic food more often than Chinese, and the high price is the biggest hindering reason for them to buy organic food. But the income is more important for Chinese than for Hungarians to buy organic food. Food safety and health are the obvious reasons for both of them to buy organic food. Besides organic vegetables being on the top list of both Chinese and Hungarians' shopping lists, Hungarians also prefer other organic food products. Chinese can be convinced to buy organic food by relatives and friends more easily than Hungarians.

The tree table of the respondents' purchase behaviour on organic food among Chinese and Hungarians is shown in Table 2.

As mentioned above, to be proved again after the initial result discussed, we do not find the significance of food habits ('vegetarian and non-vegetarian') neither for Chinese nor for Hungarians. This result proved our H_3: Food habits (vegetarian and non-vegetarian) do not have an influence on organic food attitude.

Concluding remark. The biggest difference from buying willingness to organic food and recommendation attitude separately is country proved that there is a significant difference between Chinese and Hungarian respondents in purchase attitude to organic food. Chinese and Hungarian respondents show similar attitudes to organic food, while some different habits exist. Both Chinese and Hungarian respondents are 'not sure' to recommend organic food to other consumers because they do not trust it (Szente et al. 2007). The decision tree analysis also stopped at the initial levels. But Chinese can be convinced to buy organic food by relatives and friends more easily than Hungarians. Hungarian consumers demonstrate a more favourable attitude toward organic food than their Chinese counterparts, reflecting Hungary's more advanced organic food market (Szente et al. 2007; Balázs 2012; Ye et al. 2019). Food safety and health are the driving reasons for both Chinese and Hungarian respondents to make purchase decisions (Benedek and Balázs 2016). Organic vegetables are on the top list of both Chinese and Hungarian' shopping lists, and Hungarians also prefer other organic food products (Willer and Lernoud 2019). The ratio of Hungarian respondents who refused to buy organic food due to high price (Szente and Torma 2015) is higher than Chinese. For the Chinese, the biggest hindering reason is income (Li et al. 2019). However, this result also reflects the limitations of our primary research. Most of the respondents are young people, concentrating on the age group 21-30 years old, and this age group has obvious budget limitation features. The demand for organic food is still growing in both countries, and the supply should also grow to meet up the demands (Willer and Lernoud 2019; FiBL 2020).

Limitation. A limitation of this study is the predominant representation of younger respondents, primarily aged 21–30, a demographic likely facing budgetary constraints. Therefore, we suggest that future research continue this survey by targeting specific age groups. Besides, the imbalance in sample size between China (374) and Hungary (185) is also a limitation of this study. The imbalance in sample size cannot generally represent the whole population. When it comes to the original population of each country, the results can still offer suggestions on this topic.

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Table 2. Tree table of respondents' purchase behaviour on organic food among Chinese and Hungarian

Node	China		Hungary		Total		Predicted category	Parent node	Primary independent variable		
	n	(%)	*n*	(%)	*n*	(%)			variable	sig.[a]	split values
0	374	66.9	185	33.1	559	100.0	China	–	–	–	–
1	151	52.8	135	47.2	286	51.2	China	0	the frequency of buying organic food	0.000	often (once a week); not often (once a month); daily
2	223	81.7	50	18.3	273	48.8	China	0	the frequency of buying organic food	0.000	never; seldom (several times a year); very often (2 or 3 times per week)
3	93	46.0	109	54.0	202	36.1	Hungary	1	the information source of organic food: advertisement from market	0.000	no
4	58	69.0	26	31.0	84	15.0	China	1	the information source of organic food: advertisement from market	0.000	yes
5	195	85.9	32	14.1	227	40.6	China	2	the reason to buy organic food: food safety and health (more freshness and nutrition, no pesticides and chemical fertilisers included)	0.000	yes
6	28	60.9	18	39.1	46	8.2	China	2	the reason to buy organic food: food safety and health (more freshness and nutrition, no pesticides and chemical fertilisers included)	0.000	no
7	38	33.3	76	66.7	114	20.4	Hungary	3	Would you like to buy organic food in the future?	0.001	not like to buy it; very glad to buy it; like to buy it; against to buy it
8	55	62.5	33	37.5	88	15.7	China	3	Would you like to buy organic food in the future?	0.001	not refuse it; never buy it
9	43	62.3	26	37.7	69	12.3	China	4	the information source of organic food: social media	0.004	no
10	15	100.0	0	0.0	15	2.7	China	4	the information source of organic food: social media	0.004	yes
11	98	77.8	28	22.2	126	22.5	China	5	the reason(s) to refuse organic food: income	0.000	no

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Table 2. To be continued

Node	China		Hungary		Total		Predicted category	Parent node	Primary independent variable		
	n	(%)	*n*	(%)	*n*	(%)			variable	sig.[a]	split values
12	97	96.0	4	4.0	101	18.1	China	5	the reason(s) to refuse organic food: income	0.000	yes
13	12	44.4	15	55.6	27	4.8	Hungary	6	the reason(s) to refuse organic food: expensive price	0.007	yes
14	16	84.2	3	15.8	19	3.4	China	6	the reason(s) to refuse organic food: expensive price	0.007	no
15	21	26.3	59	73.8	80	14.3	Hungary	7	the reason(s) to refuse organic food: income	0.014	no
16	17	50.0	17	50.0	34	6.1	China	7	the reason(s) to refuse organic food: income	0.014	yes
17	32	55.2	26	44.8	58	10.4	China	9	the information source of organic food：shop keeper and retailer	0.005	no
18	11	100.0	0	0.0	11	2.0	China	9	the information source of organic food：shop keeper and retailer	0.005	yes
19	55	69.6	24	30.4	79	14.1	China	11	the information source of organic food：advertisement from market	0.004	no
20	43	91.5	4	8.5	47	8.4	China	11	the information source of organic food：advertisement from market	0.004	yes
21	85	97.7	2	2.3	87	15.6	China	12	the information source of organic food：relatives and friends	0.033	no
22	12	85.7	2	14.3	14	2.5	China	12	the information source of organic food：relatives and friends	0.033	yes
23	20	31.3	44	68.8	64	11.4	Hungary	15	the reason to buy organic food: food safety and health (more freshness and nutrition, no pesticides and chemical fertilisers included)	0.042	yes
24	1	6.3	15	93.8	16	2.9	Hungary	15	the reason to buy organic food: food safety and health (more freshness and nutrition, no pesticides and chemical fertilisers included)	0.042	no
25	22	46.8	25	53.2	47	8.4	Hungary	17	which organic food product(s) do you/ would you like to buy: organic milk	0.008	no

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Table 2. To be continued

Node	China		Hungary		Total		Predicted category	Parent node	Primary independent variable		
	n	(%)	*n*	(%)	*n*	(%)			variable	sig.[a]	split values
26	10	90.9	1	9.1	11	2.0	China	17	which organic food product(s) do you/ would you like to buy: organic milk	0.008	yes
27	10	50.0	10	50.0	20	3.6	China	19	which organic food product(s) do you/ would you like to buy: organic vegetables	0.027	no
28	45	76.3	14	23.7	59	10.6	China	19	which organic food product(s) do you/ would you like to buy: organic vegetables	0.027	yes

[a]Bonferroni adjusted; growing method = Exhaustive CHAID; dependent variable = country
sig. – * p < .05, ** p < .01, *** p < .001

CONCLUSION

In conclusion, while both Hungarian and Chinese respondents are hesitant to recommend organic food due to trust issues, Chinese consumers are more easily persuaded by friends and family. Hungarian consumers purchase organic food more frequently, reflecting differences in market development and consumer trust between the two countries. The findings underscore a shared demand for organic food, driven by food safety, health, and environmental concerns, and suggest areas for future research and industry focus. It is indicated for Chinese and Hungarian policymakers or producers to improve consumer trust through product labelling. This research result cannot stand for the typical purchasing behaviour, but it can give future researchers or food producers some directions or ideas. However, it should also be noted that the majority of respondents are between 21 and 30 years old, which limits the generalisability of the results to the entire population.

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