

Factors influencing vegetable cooperatives' selection of marketing channels in Beijing

Marketing
channels in
Beijing

Chenchi Zhang, Jieqiong Wang, Biao Zhang, Junqi Ding, Zetian Fu
and Lingxian Zhang
China Agricultural University, Beijing, China

1655

Received 31 July 2018
Revised 19 November 2018
Accepted 30 November 2018

Abstract

Purpose – The selection of marketing channels by vegetable producers directly affects the income of producers and is important for the maintenance of a stable supply of vegetables and food control. The purpose of this paper is threefold: to investigate the cooperative selection of vegetable marketing channels; to identify the factors that influence the selection of marketing channels by professional vegetable cooperatives by comparing emerging and traditional circulation modes; and to solve the problems related to vegetable circulation channels in Beijing.

Design/methodology/approach – A total of 187 valid questionnaires were collected from seven main vegetable production districts in Beijing urban areas from September to December 2017, with a response rate of 89 percent. Binary logistic regression was used for analysis in this study.

Findings – Results revealed that the cooperatives mainly selected large wholesalers, wholesale markets, supermarkets and electronic commerce as their marketing channels for their vegetables. Estimation results showed that among the 18 influencing factors in the four categories, the educational level of the person in charge and some other factors significantly influence the selection of these four distribution channels by the cooperatives.

Research limitations/implications – Due to the lack of time and energy, this paper does not analyze the factors influencing a cooperative's choice of different e-commerce platforms. If this problem can be solved, it will definitely promote the development of e-commerce in rural areas.

Originality/value – The results obtained in the present study and their implications could help policy makers establish a science-based and reasonable policy to encourage vegetable producers to participate in the new circulation modes of vegetables in Beijing and ensure their income in the vegetable supply chain. This study suggests methods to improve the vegetable sector in other cities facing similar issues.

Keywords China, Vegetables, Cooperatives, Distribution channels and markets, Binary logistic regression, Choice behaviours

Paper type Research paper

1. Introduction

As an important source of calories, vitamins, dietary fiber and special nutrients, vegetables play a vital role in the human diet (Ionescu and Roman, 2015; Saba *et al.*, 2018; Xu *et al.*, 2015). Total vegetable consumption has increased globally over the last ten years (Storey and Anderson, 2018; Ceuppens *et al.*, 2014). A typical international metropolis, Beijing, exhibits a considerably higher vegetable consumption than that of the national average. In 2012, the per capita vegetable consumption reached 160 kg, which was about 48 kg higher than the national average (Panda and Sreekumar, 2012; Li *et al.*, 2016; Zhang *et al.*, 2011). To improve the income of the producers and ensure the self-sufficiency rate of vegetables, the municipal government of Beijing implemented a number of support policies represented by the Vegetable Basket Project by developing metropolis-type modern agriculture. However, several problems impede the development of the vegetable industry in Beijing, such as insufficient self-sufficiency and unbalanced supply and demand.

The authors would like to acknowledge the financial support from Beijing Social Science Foundation (16YJA007) and the Beijing Leafy Vegetables Innovation Team of Modern Agro-industry Technology Research System (BAIC07-2019).



British Food Journal
Vol. 121 No. 7, 2019
pp. 1655-1668
© Emerald Publishing Limited
0007-070X
DOI 10.1108/BFJ-06-2018-0403

With the rapid development of e-commerce in recent years, new types of vegetable circulation channels have emerged, providing convenient way to purchase agricultural products from different parts of the world. However, the main vegetable circulation channel in Beijing is still the large-scale wholesale market, comprising 70 percent, whereas the emerging farmer–supermarket direct-purchase mode only comprising 10 percent of the wholesale market (Man, 2009). As the link between producers and consumers, the vegetable circulation channel can effectively regulate the balance between supply and demand and the production profit (Kou and Tan, 2008). There has been a large amount of research on the vegetable circulation channel to improve the development of the vegetable industry in Beijing.

A review of previous research on the vegetable circulation channel indicates that most of these studies are mainly focused on the circulation efficiency and consumption (Hsu *et al.*, 2017; Bond *et al.*, 2009; Li and Mu, 2017). Although the initial end of the supply chain (production) is initially important to ensure the high quality and stable supply of vegetables in Beijing, studies on vegetable producers are rarely reported. Previous studies on producers are focused on decentralized individual farmers. Slamet *et al.* (2017) examined the factors that determine the participation of farmers in the vegetable circulation channel, as well as the effect on their income; Li and Mu (2017) compared and analyzed the wholesale market-dominated distribution channels from the perspective of farmers by using the data envelopment analysis-Tobit regression model; and Zhang *et al.* (2017) analyzed the willingness and behavior of the vegetable distribution channel.

Although vegetable producers in Beijing mainly consist of households, they are scattered and disproportionate. Most of them rely on traditional circulation channels to sell their vegetables, the effect of lack of scale, vulnerability to risks and restriction of the development of vegetable circulation (Wang *et al.*, 2012; Zhu and Wang, 2009; Zhang *et al.*, 2013). The emerging professional vegetable cooperatives can link farmers and consumers and exhibit large-scale production patterns that can effectively combine with e-commerce and solve the problems faced by farmers. This role will be mainly played by vegetable producers in the future.

Each channel has its own practical complexity; thus, the effect is not as creative (Zhou and Lu, 2008). This characteristic implies the importance of analysis of the selection behaviors of cooperatives and influencing factors of distribution channels to determine the operating mechanism of the vegetable circulation channel and thus improve their effectiveness.

This study aims to identify the factors influencing the selection decisions of professional vegetable cooperatives by comparing the emerging and traditional circulation modes. This study also intends to address the problems encountered by vegetable circulation channels in Beijing. Promoting consistency between the healthy development of the vegetable industry and the agricultural supply side reform in Beijing is important.

2. Materials and methods

2.1 Data collection

This study conducted a cross-sectional survey involving the characteristics of the person in charge, organization, vegetable production and sales, among others, in Beijing. With the approval of Beijing Municipal Bureau of Agriculture through the Beijing Innovation Consortium of Agriculture Research System, leaders from agricultural technology promotion stations and field schools were selected in all districts and counties of Beijing to train researchers on the contents and concepts that need to be incorporated in the questionnaires. For each district and county, 30 questionnaires were distributed to new business entities. A total of 210 new business entities from seven districts were investigated, and 156 questionnaires were used, 98 percent of which consist of cooperatives. Therefore, the subsequent business entities used as research objects were cooperatives. The questionnaires were completed using a combination of household surveys and interviews to

improve the accuracy of the survey results. Together with the sample data investigated, these samples were evenly and extensively distributed. The samples were highly representative and satisfied the data analysis requirements for the self-produced vegetable circulation model in Beijing.

2.2 Theoretical model

Logistic regression is widely used in scientific research and application analysis (Assi *et al.*, 2018; Zhu *et al.*, 2018; Xiong and Zuo, 2018). According to the values of the dependent variables, logistic regression can be divided into binary logistic regression analysis and multinomial logistic regression analysis. The dependent variable in binary logistic regression analysis can only be 0 or 1 (virtual dependent variable). We select the first four distribution channels from the vegetable sales channels selected by cooperatives and the proportion of sales. Each vegetable sales channel has only two choices: adoption and non-adoption. Meanwhile, the variables are discrete but not continuous. Therefore, adopting the binary logistic method is preferred to build a model for the adoption of the vegetable sales channels selected by cooperatives and to compare the channels four times. Setting willingness as the dependent variable, a 0–1 variable, with adoption denoted by 1 and non-adoption by 0, we use a logistic regression model to define the value of the dependent variable in the range [0, 1]. The general form of the logistic model is as follows:

$$p_i = F\left(\alpha + \sum_{j=1}^m \beta_j X_{ij}\right) = \frac{1}{1 + \exp\left(-\alpha + \sum_{j=1}^m x_{ij}\right)}, \quad (1)$$

$$p = \ln \frac{p}{1-p} = \alpha + \sum_{j=1}^m \beta_j X_j, \quad (2)$$

where formula (1) indicates the probability that the cooperative adopts; I is the number of cooperatives, representing the regression coefficient of the influencing factor; j is the number of influencing factors; m is the number of factors affecting this probability; and M indicates the number of factors affecting this probability, which is the independent variable and represents the intercept of regression. The formula is also given by Formula (2).

3. Results

3.1 Analysis of the choice by cooperatives and sales volume ratio

The vegetable sales channels of producers in Beijing mainly consist of sales cooperatives, large wholesalers, rural brokers, supermarkets, processing companies, farmers' markets, wholesale markets, roadside markets and e-commerce platforms. These channels exhibit distinct characteristics and adaptability. We can divide them into five major modes: the order model based on acquisitions by corporations and sales cooperatives, the direct supply model based on supermarkets and canteens, the broker–vendor model based on personal wholesalers, the traditional model of sales in farmers' markets and the e-commerce model. Owing to various influencing factors and external forces, most cooperatives cannot complete the sale of all vegetables through a single channel. To maximize profits, producers often choose multiple combinations of the most cost-effective sales channels. Given this combination option, our design of the questionnaire needed to be more realistic; thus, we designed a multiple-choice questionnaire. The final statistical analysis can comprehensively explain the actual problems.

The downstream distributors of the cooperatives under investigation mainly consists of sales cooperatives, large wholesalers, rural brokers, supermarkets, processing companies, farmers' markets, wholesale markets, roadside markets and e-commerce platforms. The questionnaire provides multiple choices and no mutual exclusion; thus, the frequency ratio is divided by the total number of valid questionnaires (156). The distribution channels are listed by their frequency ratios in the descending order, as follows (Table I): large wholesalers (42 percent) > wholesale markets (40 percent) > supermarkets (31 percent) > e-commerce (29 percent) > farmers' market (19 percent) = sales cooperatives (19 percent) > rural brokers (11 percent) = processing companies (11 percent) > roadside markets (8 percent).

As shown in the Table I, 42 percent of the cooperatives choose to sell vegetables to large-scale wholesalers owing to several factors, such as quality, scale and geographical advantage. This percentage is slightly lower than that of farmers (42.12 percent) (Zhang *et al.*, 2017). Beijing has a large number of agricultural leading corporate headquarters gathered here, and owing to the timeliness and radius of vegetables, local-scale cooperatives of Beijing have a very good opportunity for development. It varies from ordinary farmers in that cooperatives are more qualified to meet the requirements of large wholesalers in the production, management, storage and packaging of vegetable products.

Up to 40 percent of cooperatives sell to the wholesale market. Wholesalers and retailers in the wholesale market are not as large-scale as large wholesalers and cannot effectively enough use the brand effect to form advantages and quantification; however, a large number of small wholesalers in the wholesale market are still favored by cooperatives, second to large wholesalers.

In sum, 31 percent of cooperatives sign orders with supermarkets, which is far higher than the 2.62 percent of rural households (Zhang *et al.*, 2017).

Also, 29.49 percent of the cooperatives sell vegetables through e-commerce. Among cooperatives that sell vegetables via e-commerce, the average e-commerce sales of vegetables accounts for 23 percent of the total output value. Moreover, 63 percent of the cooperatives believe that the price of vegetables sold through the network is similar to those sold through traditional channels, whereas 30 percent of the cooperatives perceive the network selling price to be higher than the market selling price. Among cooperatives that do not use e-commerce, up to 86 percent are very willing to learn and use e-commerce, whereas 14 percent view the use of e-commerce as having little effect on them; no cooperatives are reluctant to use e-commerce.

In production, farmers have a small scale of production and few types, and 18.32 percent of farmers tend to sell in farmers' markets (Zhang *et al.*, 2017). By contrast, although 19 percent of the surveyed cooperatives choose to sell to the farmers' market, the least preferred circulation channels are farmers' markets. Apart from wasting time, wasting labor and not favoring brand building, the large supply of goods or the distance is one of the reasons a considerable number of cooperatives refuse to sell to farmers' markets.

Items	Frequency	Frequency ratio (%)
Large wholesalers	65	42
Wholesale markets	63	40
Supermarkets	48	31
E-commerce	46	29
Farmers' market	29	19
Sales cooperatives	29	19
Rural brokers	17	11
Processing companies	17	11
Roadside markets	12	8

Table I.
Cooperative sales
channel selection

3.2 Framework of influencing factors

3.2.1 *The framework of influencing factors.* The four aforementioned factors comprise the main factors affecting the choice of vegetable marketing channels among cooperatives. Analysis of the cross-tabulations of these four major categories of 18 factors, and the selection of vegetable distribution channels indicates that the differences in these factors prompt cooperatives to choose different vegetable distribution channels. A further χ^2 test of these factors and the selection of vegetable distribution channels show that the identity of the person in charge, educational level, training of farmers, adoption of e-commerce and distance from market towns are significant at the 0.05 level. That is, these factors can significantly change the choice of vegetable distribution channels for farmers.

However, the choice of vegetable distribution channels is the result of the combined effects of different factors. Some factors may not change the behavior of cooperatives individually unless other factors change. Some factors may change the choice of vegetable channels even if other factors do not change. However, a change in other factors may not change the cooperative selection behavior. Therefore, to better analyze the effect of these factors on the distribution channel selection of vegetable cooperatives, these factors need to be systematically and comprehensively analyzed and taken into consideration. Thus, a framework of factors affecting cooperatives' choice of vegetable distribution channels is constructed (Figure 1).

3.2.2 *Interpretation of model variables.* Theoretical framework analysis identifies 18 independent variables and 1 dependent variable involved in the framework and model of the factors affecting distribution channel selection among vegetable cooperatives. These variables are presented in Table II.

Analysis of the survey data shows that the principals of cooperatives that choose large wholesalers are mainly ordinary villagers, and the number of party members and outsiders is half the number of ordinary villagers. Moreover, the principals of the cooperatives that choose large wholesalers are mainly ordinary villagers, and the number of party members and the number of outsiders is both half that of ordinary villagers. The average number of villagers that choose wholesale markets is twice the number of party members; the persons in charge who choose e-commerce as sales channels mainly consist of ordinary villagers and foreigners.

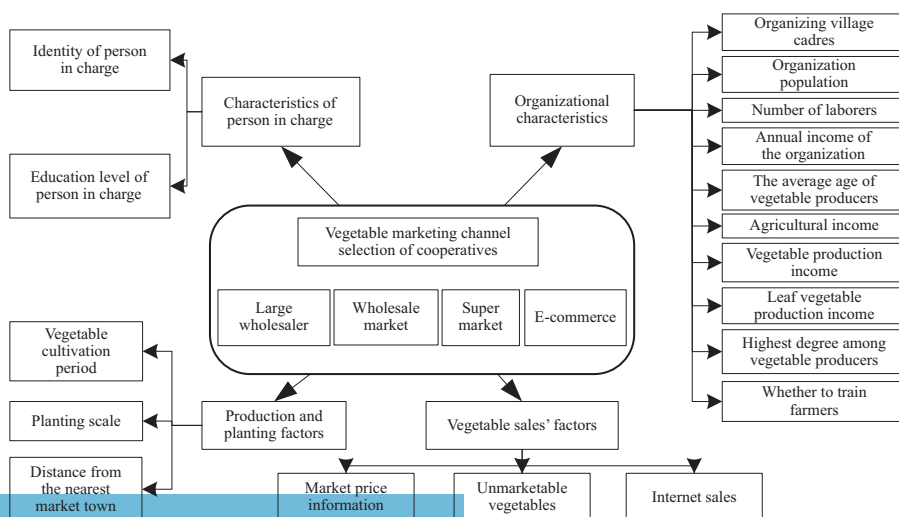


Figure 1. Framework of factors affecting sales channel selection among vegetable cooperative

Variables	Symbols	Definitions
Dependent variable Whether the circulation channel is adopted Large-scale wholesale market	y	adoption = 1, non-adoption = 0;
<i>(1) Characteristics of person in charge</i>		
Identity	X_1	1 = village cadres; 2 = party members; 3 = veterans; 4 = ordinary villagers; 5 = foreigners
Educational level	X_2	1 = no schooling; 2 = primary school; 3 = junior high school; 4 = high school (vocational high school, secondary school); 5 = college; 6 = undergraduate and above
<i>(2) Organizational characteristics</i>		
Organizing village cadres	X_3	Is there any village cadre among the members of the cooperative: 1 = yes, 0 = no
Organization population	X_4	Measured by the total number of people in the year before the survey was completed by the organization; the unit is one
Number of laborers engaged in vegetable production	X_5	Measured by the total population in the year before the survey was completed; the unit is one
Average age of vegetable producers	X_6	1 = 20–30 years, 2 = 31–40 years, 3 = 41–50 years, 4 = 51–60 years, 5 = 61 years or older
Annual income of the organization	X_7	Before the investigation, the income is measured in yuan
Agricultural income	X_8	Before the investigation, the income is measured in yuan
Vegetable production income	X_9	Before the investigation, the income is measured in yuan
Leaf vegetable production income	X_{10}	Before the investigation, the income is measured in yuan
Highest degree among vegetable producers	X_{11}	1 = elementary school and below; 2 = junior high school; 3 = high school (vocational high school, secondary school); 4 = college; 5 = undergraduate and above
Whether to train farmers	X_{12}	1 = training, 2 = no training
<i>(3) Production and planting factors</i>		
Vegetable cultivation period	X_{13}	Actual number of years of vegetable cultivation
Planting scale	X_{14}	Measured in vegetable planting area, the unit is mu. (1 mu equals to 667 m ²)
Distance from the nearest market town	X_{15}	Actual distance from the nearest market town to vegetable planting areas
<i>(4) Factors affecting vegetable sales</i>		
Market price information	X_{16}	Whether cooperatives pay attention to market vegetable price information: 1 = very concerned, 2 = not paying attention, 3 = no matter
Unmarketable vegetables	X_{17}	Whether the vegetables are unmarketable: 1 = exists, 2 = does not exist, 3 = differs from year to year
Internet sales	X_{18}	Whether to use online sales: adoption = 1, non-adoption = 0

Table II.
Explanation of variables in the model

The responsible persons involved in the selection of the four major distribution channels mostly consist of ordinary villagers; few village cadres and veterans are involved.

3.2.3 Descriptive statistics analysis of the factor variables. The descriptive statistics of the factor variables in the behavioral analysis of the model of cooperative selection of distribution channels are shown in Table III. All responsible persons are relatively highly educated, and most of them have attained high school education or above. With regard to organizational characteristics, relatively few organizations have village cadres, and a relatively large number of organizations choose the wholesale market. Those engaged in vegetable production are

Variables	Descriptive statistics for selecting large wholesalers ($n = 156$)				Descriptive statistics for selecting the wholesale market ($n = 156$)			
	Min.	max.	Aver.	SD	Min.	Max.	Aver.	SD
X_1	1	5	3.17	3.17	1	5	3.32	1.37
X_2	1	6	4.03	4.03	1	6	3.76	1.21
X_3	0	1	0.37	0.37	0	1	0.39	0.49
X_4	2	684	51.78	51.78	2	2,000	71.37	204.78
X_5	1	360	41.23	41.23	1	1,000	45.31	108.39
X_6	1	4	3.18	3.18	0	4	3.18	0.75
X_7	5	3,000	295.08	295.08	4	3,000	279.02	435.38
X_8	1	2,700	232.55	232.55	4	2,000	242.6	353.61
X_9	2	2,700	186.75	186.75	2	1,700	178.34	278.84
X_{10}	0	2,700	128.74	128.74	0	1,500	114.97	204.29
X_{11}	1	5	3.29	3.29	1	5	3.18	1.14
X_{12}	0	1	0.85	0.85	1	2	1.22	0.42
X_{13}	1	35	11.37	11.37	2	35	11.58	7.84
X_{14}	3	1,350	227.54	227.54	3	1,974	192.38	250.36
X_{15}	1	550	48.26	48.26	1	25,000	301.75	2,349.3
X_{16}	0	3	1.02	1.02	1	3	1.22	0.53
X_{17}	1	3	2.08	2.08	1	3	1.96	0.86
X_{18}	0	1	0.44	0.44	0	1	0.44	0.5

Variables	Descriptive statistics for selecting supermarkets ($n = 156$)				Descriptive statistics for selecting e-commerce ($n = 156$)			
	Min.	max.	Aver.	SD	Min.	Max.	Aver.	SD
X_1	1	5	3.42	1.2	5	3.45	1.27	5
X_2	1	5	3.7	1.1	6	3.88	1.06	6
X_3	0	1	0.32	0.47	1	0.33	0.47	1
X_4	2	684	58.77	92.74	684	48.37	79.88	684
X_5	1	1,000	43.23	107.42	1,000	45.44	106.75	1,000
X_6	1	5	3.23	0.71	5	3.18	0.75	5
X_7	5	3,000	252.5	437.8	3,000	272.19	453.09	3,000
X_8	1	2,700	213.2	359.18	2,700	191.23	341.78	2,700
X_9	0	2,700	187.8	334.36	2,700	170.8	317.94	2,700
X_{10}	0	780	103.6	153.77	2,700	101.71	272.38	2,700
X_{11}	1	5	2.98	1.08	5	3.01	1.07	5
X_{12}	0	1	0.71	0.46	1	0.79	0.41	1
X_{13}	2	2,015	29.65	191.18	35	11.73	8.09	35
X_{14}	1	1,350	229.9	285.81	3,000	257.74	394.43	3,000
X_{15}	1	25,000	281.5	2,382.32	30,000	427.69	290.21	30,000
X_{16}	1	3	1.19	0.48	3	1.17	0.48	3
X_{17}	1	3	2.03	0.88	3	2.09	0.85	3
X_{18}	0	1	0.45	0.5	1	0.33	0.47	1

Table III.
Descriptive statistics for explanatory variables

generally between the ages of 41–50 years, and the degree of professional production is relatively high. Vegetable producers have academic qualifications lower than those of the person responsible for the cooperative although persons in charge also generally reach high school levels. Data on factors related to production and planting are relatively scattered.

3.3 Analysis and discussion of results

By using SPSS 20.0 to perform binary regression on the data, multiple statistical coefficients were obtained. The estimated results are shown in Table IV.

3.3.1 Overall model fitting analysis. The logistic regression model fitting of sales channel selection by vegetable cooperatives is used to test the validity of the final equation; that is, the global test of the model. The significance level (sig) value is 0.000, which is less than 0.05; thus, the equation is generally valid.

y	Wholesalers			Wholesale market		
	B	Wald	Sig.	B	Wald	Sig.
Intercept	-39.53	6	0.995	-756.133	4.002	0.96
X ₁	0.835***	5.505	0.019	45.234*	1.003	0.053
X ₂	1.681***	6.594	0.01	123.797*	1.011	0.055
X ₃	3.791***	5.855	0.016	-0.303	2.274	0.062
X ₄	-0.013	1.595	0.128	0.774	3.662	0.735
X ₅	0.02	2.421	0.12	-3.454	1.006	0.613
X ₆	0.719*	1.066	0.092	-28.851	0.001	0.162
X ₇	0.003	0.718	0.397	0.115	0.652	0.992
X ₈	-0.002	0.623	0.43	-0.894	1.220	0.962
X ₉	-0.002	0.167	0.682	0.067	0.213	0.993
X ₁₀	-0.004**	1.33	0.049	-0.766*	2.001	0.071
X ₁₁	2.265**	7.916	0.025	247.5**	5.007	0.036
X ₁₂	2.892*	3.632	0.057	-53.057*	7.552	0.042
X ₁₃	0.083	1.177	0.278	9.312	1.423	0.457
X ₁₄	-0.002*	5.684	0.088	-1.555**	1.012	0.013
X ₁₅	-0.011*	2.891	0.019	12.694***	2.013	0.009
X ₁₆	19.782	1.003	0.167	-19.206	0.220	0.142
X ₁₇	0.931	0.528	0.266	-57.681**	3.956	0.043
X ₁₈	-0.807*	1.546	0.06	102.027**	5.009	0.025

y	Supermarket			E-commerce		
	B	Wald	Sig.	B	Wald	Sig.
Intercept	-809.191	7.003	0.954	-220.632	3.001	0.96
X ₁	79.583**	4.011	0.015	25.234*	2.002	0.062
X ₂	50.5	0.005	0.945	101.332***	8.021	0.005
X ₃	80.595**	2.005	0.044	-0.313*	1.003	0.051
X ₄	1.872	0.008	0.527	0.774	0.405	0.935
X ₅	-0.676	1.204	0.965	-2.444	2.022	0.113
X ₆	3.76	0.005	0.287	-3.772	1.002	0.182
X ₇	0.158	0.003	0.956	0.115	0.211	0.992
X ₈	-0.132	1.001	0.966	-26.187	0.801	0.962
X ₉	0.058	1.201	0.972	0.667	0.985	0.993
X ₁₀	0.637**	2.001	0.023	-2.432	1.021	0.141
X ₁₁	56.924	3.202	0.139	345.7***	12.005	0.006
X ₁₂	258.394	10.023	0.133	53.057***	0.301	0.032
X ₁₃	-0.565	1.002	0.186	10.322	0.224	0.757
X ₁₄	-0.11*	4.322	0.071	6.332*	1.613	0.062
X ₁₅	-2.781**	2.016	0.044	-18.325**	4.801	0.029
X ₁₆	-140.741	1.023	0.265	-20.602	0.226	0.992
X ₁₇	31.064	2.012	0.182	56.284*	1.302	0.053
X ₁₈	220.243*	1.007	0.062	-	-	-

Table IV.
Estimates of logistic model parameters for cooperatives choosing different vegetable distribution channels

Notes: *,**,***Significant at the 10, 5 and 1 percent significance levels, respectively

Meanwhile, variables not included in the equation in different vegetable circulation channels in logistic model were selected, which is used to determine whether any variables of the model fit into the model, the goodness of fit of the entire model change is statistically significant. A comprehensive analysis leads to the conclusion that the significant levels of organization of village officials, income from vegetable production and other variables were significantly lower than 0.05, which shows that these variables significantly affect the equation and can explain the equation well. When these variables are introduced into the model, the change in the goodness of fit of the entire model is statistically significant. The significance level of the average age of workers engaged in the production of vegetables and the unsalable growth of vegetables is close to 0.05. This result shows that the

independent variables, which are the average age of laborers and the unsalable sales of vegetables, influence the choice of sales channels for vegetables but only slightly.

3.3.2 *Estimation of parameters of each variable in model.* Among the variables, only 17 independent variables are in the e-commerce circulation channels. The 18th independent variable, online sales, is designed to analyze the effect of e-commerce on the other three distribution channels and is not analyzed in e-commerce circulation (Table IV).

3.3.2.1 Influence of person in charge on cooperative choice. The influence of the identity of the person in charge on the decision of cooperatives to choose wholesalers and supermarkets as vegetable sales channels is significant at the 5 percent level; its influence on the decision of cooperative to choose wholesale markets and e-commerce as vegetable sales channels is significant at the 1 percent level; and all regression coefficients are positive. This result shows that the background identities of responsible persons more greatly influence the choice of large wholesalers and supermarkets as sales channels compared with wholesale markets because the latter are traditional relative to the four channels. However, a direct connection with large wholesalers and supermarkets requires the person in charge of the cooperative to have a certain background and vision.

The effect of the educational level of the person in charge on the cooperative selection of large wholesalers and e-commerce as vegetable sales channels is significant at the 1 percent level, and that on the cooperative selection of wholesale markets is significant at the 10 percent level. All regression coefficients are positive. This result shows that the higher the educational level of the responsible person, the higher is the probability of choosing large wholesalers and e-commerce as vegetable sales channels and the lower is the probability of choosing the wholesale market. On the one hand, farmer–supermarket direct purchase and e-commerce have emerged in recent years as the main distribution channels for vegetables because of wholesale acquisition. Persons with higher educational qualifications can learn and master new channels that are more suitable for them, whereas persons with lower academic qualifications can form the habit of selling vegetables in the market with relative ease. On the other hand, wholesalers and supermarkets that purchase vegetables set strict standards and specifications for vegetable cultivation, harvesting and packaging. Persons with higher academic qualifications are more willing to learn, analyze and improve existing production technologies and models. Adoption of e-commerce requires the person in charge to become more acquainted with new things and develop increased awareness of development and learning.

3.3.2.2 Influence of organizational characteristics on cooperative choice. Whether the village cadre influences the selection of wholesalers as a vegetable sales channel by the cooperative is significant, and both are significant at the 1 percent level. The supermarket channel is significant at the 5 percent level, and e-commerce is significant at the 10 percent level. All regression coefficients are positive and negative. This result shows whether the village cadre is a factor for the cooperative to consider in the selection of sales channels. The reason is that the village cadres in the organization have more connections with the government and other channels of information, which can often receive new information to change the operating status of the cooperatives. On the other hand, as village cadres, they are willing to take more responsibility and make suggestions for the development of cooperatives. In recent years, the government has been intensively guiding producers in the adoption of new distribution channels based on e-commerce. If the person in charge is a village cadre, it is bound to be more highly affected by the village cadres.

The influence of the number of organizations on the selection of large wholesalers, wholesale markets, supermarkets or e-commerce is not significant. This result shows that the number of the organization's population has no effect on the selection of vegetable distribution channels by cooperatives.

The income of leaf vegetable production significantly affects the selection of large wholesalers and supermarkets as vegetable sales channels by the cooperative at the 5 percent level; the regression coefficient is positive. In addition, the effect of selecting wholesale markets as vegetable sales channels is significant at the 10 percent level; and the regression coefficient is negative. The effect on the choice of e-commerce channels is not significant. This result shows that leafy vegetables affect the choice of sales channels to a certain extent because of their own characteristics, particularly fixed sales such as wholesale markets and large wholesalers. Selling leafy vegetables through e-commerce meets the high demand for product quality and timeliness, which is not appropriate for cooperatives.

The high educational level of laborers in cooperatives is significant for cooperatives choosing e-commerce as a sales channel. In addition, it significantly affects the selection of wholesale markets and large wholesalers as vegetable sales channels. Meanwhile, no significant effect on the cooperative selection of supermarket as a vegetable sales channel is indicated. This finding also confirms that the higher the academic qualifications of vegetable producers, the higher is the probability that e-commerce and wholesale markets would be chosen as sales channels. The higher the academic qualifications of the producers, the greater knowledge in social production and circulation they could master. When they have increased ability to collect information, producers can select more appropriate channels that can benefit vegetable sales.

Training for farmers significantly affects the selection of e-commerce as a vegetable sales channel by the cooperative at the 1 percent level and the selection of wholesale markets and large wholesalers as vegetable sales channels at the 10 percent level. This result shows whether training farmers affect the choice of supermarkets as sales channels. However, cooperatives with trained farmers are more likely to choose e-commerce sales channels. Cooperative selection of e-commerce involves a large amount of training and studies. Cooperatives that have the needs and ideas for training of farmers have increased interest in exploring new circulation channels.

3.3.2.3 Influence of production and planting factors on cooperative choice. The number of years in which the cooperatives are engaged in vegetable cultivation exerts no significant effect on the selection of wholesalers, wholesale markets, supermarkets and e-commerce by cooperatives. This result shows that the vegetable cultivation years do not affect the selection of vegetable distribution channels by cooperatives. The effect of the scale of vegetable cultivation on the cooperative selection of wholesale markets as vegetable sales channels is significant at the 5 percent level. Its effect on the cooperative selection of large wholesalers, supermarkets and e-commerce as sales channels is significant at the 10 percent level, and both of the regression coefficient are negative. This result indicates that the larger the cooperative, the lower is the probability of choosing wholesalers and supermarkets as sales channels, and the greater is the probability of selecting the wholesale market as the sales channel. The reason is that cooperatives with larger planting scales have higher yields and greater advantages in the competition for vegetable circulation. They have sufficient products to sell directly to consumers and middlemen through the wholesale market and can earn more profits.

The effect of the distance between cooperatives and recent market towns on the selection of wholesale markets as vegetable sales channels by the cooperative is significant at the 1 percent level. In addition, the effect of the aforementioned distance on the selection of wholesalers, supermarkets and e-commerce as vegetable sales channels by the cooperative is significant at the 5 percent level. All regression coefficients are negative. This result shows that the larger the distance between the cooperative and the nearest market town, the less likely the wholesale market would be chosen compared with wholesalers, supermarkets and e-commerce. The farther away from the wholesale market, the higher the circulation costs of vegetables when distributed through the wholesale market and the smaller the profit margins. For e-commerce and other sales channels, mature transportation systems

and efficient sales methods also encourage cooperatives, which are far from the markets, to exert increased effort and time to choose new circulation channels.

3.3.2.4 Influence of vegetable sales as a factor on cooperative choice. The acquisition of information on market vegetable prices has no significant effect on the selection of wholesalers, supermarkets, wholesale markets and e-commerce by cooperatives. "Whether vegetables are unmarketable" has no significant effect on the cooperative selection of large wholesalers and supermarkets as vegetable sales channels. In addition, "Whether vegetables are unmarketable" has impact on the cooperative selection of wholesale markets is significant at 5 percent, both of the regression coefficient are positive. It is significant in the cooperative selection of e-commerce as a sales channel at the 10 percent level. This finding suggests that poor vegetable sales can more likely induce cooperatives to choose the wholesale market, rather than supermarkets and wholesalers, as the distribution channel. The reason is that when cooperatives contract with supermarkets and large wholesalers to sell vegetables, the output is fixed and flexibility is extremely limited. Selling vegetables in the wholesale market allows the wholesale market to make long-term stable purchases of cooperative vegetables. When vegetables are unmarketable, cooperatives can use other methods to sell vegetables. E-commerce can quickly and efficiently to supplement the sales.

The effect of e-commerce on traditional circulation channels is reflected by "whether or not to use online channel sales." For the cooperatives that choose wholesalers and supermarkets as the main distribution channels, the effect of e-commerce is significant at the level of 10 percent. For the cooperatives that choose the wholesale market as the main distribution channels, the effect of e-commerce is significant at the 5 percent level. This result indicates that the cooperatives choosing the wholesale market as the sales channel are more likely to choose e-commerce sales. Meanwhile, the cooperatives, instead of using e-commerce sales, will less likely to choose large wholesalers and supermarkets. The reason is that cooperatives who choose large wholesalers and supermarkets generally have a fixed amount of sales. Simultaneously, owing to restrictions on brands by supermarkets and large wholesalers, cooperatives do not have much space to use e-commerce for selling their own products. However, the cooperatives that choose the wholesale market have greater flexibility because the wholesale market sales are not fixed; when slow-moving sales occur, e-commerce can be adopted as a supplement channel to expand the sales volume.

4. Conclusions and discussion

This study first analyzes the cooperative selection of vegetable distribution channel and sales volume ratio. Cross-tabulation analysis of multiple factors and cooperative selection behavior of vegetable distribution channels is conducted, and the influencing factor framework for the cooperative selection of vegetable distribution channels is constructed. The selection model is further established. Finally, a binary logistic selection model for vegetable distribution channels is established, and the influence of different factors on the choice of vegetable distribution channels is quantitatively analyzed. The main conclusions are as follows:

- (1) The vegetable distribution channels of Beijing cooperatives mainly consist of large wholesalers, rural brokers, supermarkets, processing companies, farmers' markets, wholesale markets, roadside markets and e-commerce platforms. The proportion of distribution channels selected by cooperatives is as follows: large wholesalers (42 percent) > wholesale markets (40 percent) > supermarkets (31 percent) > e-commerce (29 percent) > farmers' market (19 percent) = sales cooperatives (19 percent) > rural brokers (11 percent) = processing companies (11 percent) > roadside markets (8 percent).

Studies have found that Beijing, as an antecedent of policy and technology, exhibits a considerably high adoption of e-commerce as a new type of distribution channel. However, as the main source ensuring emergency supply, the self-produced agricultural products of Beijing have shown high production costs, single brands and labor shortages.

- (2) The persons in charge of the cooperatives mainly consist of ordinary peasant households. A small number consists of village cadres is not large. The persons in charge who choose farmer–supermarket direct purchase are mostly members of the Communist Party of China. The ages of producers in cooperatives are concentrated between 41 and 50 years, and the production level is relatively high. A small number of cooperatives own village cadres. Most cooperatives are concerned about and know the market price of vegetables. Half of the vegetables of the cooperatives are unmarketable. Nearly half of the cooperatives choose to adopt e-commerce sales.
- (3) The fitting effect of the logistic model for cooperatives that choose different vegetable sales channels is preferable. Among the 18 influential factors in the four categories, the educational level of the person in charge, identity of the person in charge, presence of a village cadre in the organization and distance from the market town significantly influence the selection of large wholesalers by the cooperatives. The educational level of the person in charge, qualifications of the person in charge, scale of cultivation, distance from the market town, highest academic record among the vegetable producers, and whether or not the farmer is trained significantly influence the cooperative selection of the wholesale market as a distribution channel. The identity of the person in charge, presence of a village cadre in the organization, income from the production of leafy vegetables and distance from the market town significantly influence the cooperative selection of supermarkets as vegetable distribution channels. The educational level of the person in charge, highest academic record among vegetable producers, whether or not the farmer is trained and the presence of village leaders in the organization significantly affect the cooperative selection of supermarkets as vegetable distribution channels.

In order to optimize the environment of circulation channels, the government should formulate scientific standards and appropriate management policies.

It is necessary for the government to continuously strengthen its support for main new agricultural business entities, advocate farmers joining cooperatives to reinforce competitiveness in the vegetable market. Especially, by giving publicity and guidance on non-party principals, it will be more beneficial to the execution of policies.

In addition, the government should issue more powerful policies to encourage rural areas to actively introduce excellent highly-educated talents so as to drive the development of circulation channels. In the meanwhile, it is also important to establish a training system, intensify the publicity and training by the introduced talents in the local areas, build the awareness of vegetable brand sales and decrease the cost of storage and circulation. Besides, the government should provide necessary capital and technology to optimize the traditional vegetable circulation channels, improve the efficiency of vegetable circulation and guide producers to choose new vegetable circulation channel modes.

To effectively support the local producers in a targeted way, the government can better obtain an understanding of the main circulation channels as well as the production and operation situations of every producer. To be more specific, it can classify the vegetable producers to create a multi-type, multi-layered and diversified environment for vegetable circulation channels; to help the producers that do not have many new circulation channels to choose from, the government should not only strengthen the publicity and guidance on the persons in charge, but also intensify and supervise the organizing and training carried out by the principals on the producers in general, not only the village cadres.

References

- Assi, K.J., Nahiduzzaman, K.M., Ratrout, N.T. and Aldosary, A.S. (2018), "Mode choice behavior of high school goers: evaluating logistic regression and MLP neural networks", *Case Studies on Transport Policy*, Vol. 6 No. 2, pp. 225-230.
- Bond, J.K., Thilmany, D. and Bond, C. (2009), "What influences consumer choice of fresh produce purchase location?", *Journal of Agricultural and Applied Economics*, Vol. 41 No. 1, pp. 61-74.
- Ceuppens, S., Hessel, C.T., Rodrigues, R.Q., Bartz, S., Tondo, E.C. and Uyttendaele, M. (2014), "Microbiological quality and safety assessment of lettuce production in Brazil", *International Journal of Food Microbiology*, Vol. 181, pp. 67-76.
- Hsu, J.L., Shiue, C.W. and Hung, K.J.R. (2017), "Information used in food shoppers' vegetable purchasing decisions in Chinese societies", *British Food Journal*, Vol. 119 No. 7, pp. 1487-1494.
- Ionescu, A.M. and Roman, G.V. (2015), "Study regarding the vegetables sales in various distribution channels from Bucharest", *AgroLife Scientific Journal*, Vol. 4 No. 2, pp. 33-36.
- Kou, R. and Tan, X. (2008), "Analysis framework of agricultural product circulation efficiency", *China Circulation Economy*, Vol. 5, pp. 12-15.
- Li, C., Chen, J., Wang, J., Han, P., Luan, Y., Ma, X. and Lu, A. (2016), "Phthalate esters in soil, plastic film, and vegetable from greenhouse vegetable production bases in Beijing, China: concentrations, sources, and risk assessment", *Science of the Total Environment*, Vol. 568, pp. 1037-1043.
- Li, J. and Mu, Y. (2017), "Comparison of vegetable circulation efficiency in different channels under the leading mode of wholesale market – DEA-Tobit model based on the microscopic farmer's perspective", *China Circulation Economy*, Vol. 31 No. 4, pp. 69-76.
- Man, N. (2009), "An overview of the supply chain management of Malaysian vegetable and fruit industries focusing on channel of distribution", *Industrial Catalysis*, Vol. 37, pp. 429-440.
- Panda, R.K. and Sreekumar (2012), "Marketing channel choice and marketing efficiency assessment in Agribusiness", *Journal of International Food and Agribusiness Marketing*, Vol. 24 No. 3, pp. 213-230.
- Saba, A., Moneta, E., Peparario, M., Sinesio, F., Vassallo, M. and Paoletti, F. (2018), "Towards a multi-dimensional concept of vegetable freshness from the consumer's perspective", *Food Quality & Preference*, Vol. 66, pp. 1-12.
- Slamet, A.S., Nakayasu, A. and Ichikawa, M. (2017), "Small-scale vegetable farmers' participation in modern retail market channels in Indonesia: the determinants of and effects on their income", *Agriculture*, Vol. 7, pp. 2-11.
- Storey, M. and Anderson, P. (2018), "Total fruit and vegetable consumption increases among consumers of frozen fruit and vegetables", *Nutrition*, Vol. 46, pp. 115-121.
- Wang, R.Q., Feng, J.H., Xu, X.M., Lu, P. and Wei, W.W. (2012), "Current situation, problems and countermeasures of fresh agricultural products circulation system in China", *China Fruits*, Vol. 4, pp. 25-28 (in Chinese).
- Xiong, Y. and Zuo, R. (2018), "GIS-based rare events logistic regression for mineral prospectivity mapping", *Computers & Geosciences*, Vol. 111, pp. 18-25.
- Xu, L., Lu, A., Wang, J., Ma, Z., Pan, L., Feng, X. and Luan, Y. (2015), "Accumulation status, sources and phytoavailability of metals in greenhouse vegetable production systems in Beijing, China", *Ecotoxicology & Environmental Safety*, Vol. 122, pp. 214-220.
- Zhang, B., Fu, Z., Wang, J., Tang, X., Zhao, Y. and Zhang, L. (2017), "Effect of householder characteristics, production, sales and safety awareness on farmers' choice of vegetable marketing channels in Beijing, China", *British Food Journal*, Vol. 119 No. 6, pp. 1216-1231.
- Zhang, H.Z., Li, H., Wang, Z. and Zhou, L.D. (2011), "Accumulation characteristics of copper and cadmium in greenhouse vegetable soils in Tongzhou District of Beijing", *Procedia Environmental Sciences*, Vol. 10 No. 1, pp. 289-294.
- Zhang, Y.Q., Niu, C.X. and Wang, G.Y. (2013), "Analysis of the difference advantage of vegetable professional cooperatives from the perspective of circulation", *Jiangsu Agricultural Sciences*, Vol. 41 No. 6, pp. 421-422 (in Chinese).

- Zhou, Y.H. and Lu, L.Y. (2008), "Study on the efficiency of fresh vegetable supply chain – taking Nanjing as an example", *Jiangsu Agricultural Sciences*, Vol. 1, pp. 69-72 (in Chinese).
- Zhu, J.Q. and Wang, H.W. (2009), "The analysis of vegetable circulation in China", *Modern Business Trade Industry*, Vol. 21 No. 11, pp. 11-12 (in Chinese).
- Zhu, Z., Lin, C., Zhang, X., Wang, K., Xie, J. and Wei, S. (2018), "Evaluation of geological risk and hydrocarbon favorability using logistic regression model with case study", *Marine & Petroleum Geology*, Vol. 92, pp. 65-77.

Further reading

- Schreinemachers, P., Simmons, E.B. and Wopereis, M.C.S. (2018), "Tapping the economic and nutritional power of vegetables", *Global Food Security*, Vol. 16, pp. 36-45.

Corresponding author

Lingxian Zhang can be contacted at: zhanglx@cau.edu.cn

For instructions on how to order reprints of this article, please visit our website:

www.emeraldgroupublishing.com/licensing/reprints.htm

Or contact us for further details: permissions@emeraldinsight.com

Reproduced with permission of copyright owner. Further reproduction prohibited without permission.