Adoption of Food Safety and Quality Standards by China's Agricultural Cooperatives: A Way out of Monitoring Production Practices of Numerous Small-scale Farmers ?

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Abstract

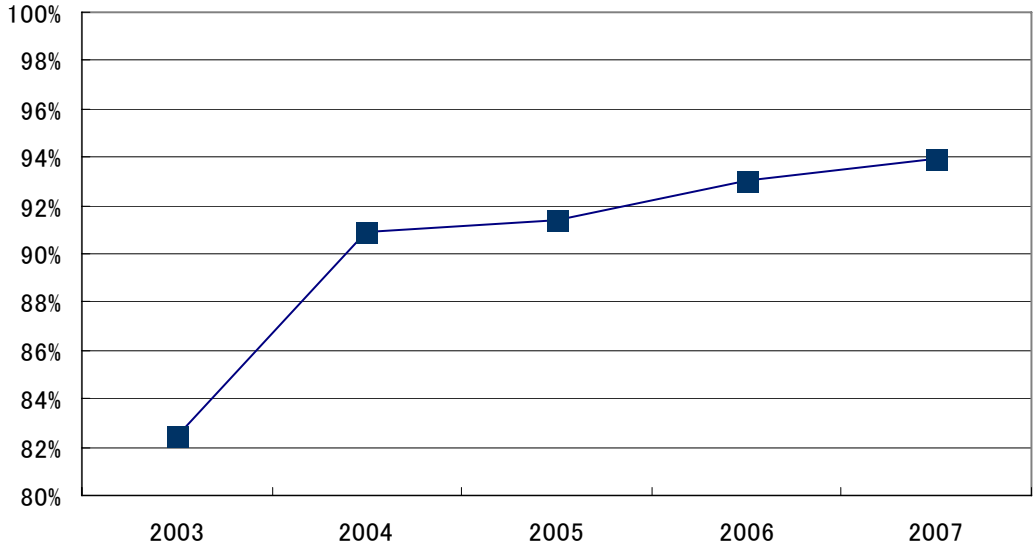
China has experienced frequently food safety scares due to pesticide residue issues in recent years. This excessive of illegal use is often tied to numerous small-scale farmers. As it is a great challenge for Chinese government to monitor production practices of small-scale farmers directly, encouraging the adoption of food safety and quality standards by China's agricultural cooperatives serves as an alternative approach to monitor the production practices of the small-scale farmers, and thus ensure improved quality of foods they produce. Based on the survey data from 124 vegetable cooperatives in Zhejiang Province, this study is designed to analyze the factors that affect adoption of food safety and quality standards by agricultural cooperatives in China. Our qualitative analysis suggests that cooperative size, perception and attitude toward standards, reputation, expected cost and benefit and the destination market have positive and statistically significant relationship with the cooperatives decision to adopt standards. The positive and significant effects of other factors such as innovativeness, price premium, customer attraction, and availability of support are not confirmed. Policy implications to encourage the adoption of food safety and quality standards by agricultural cooperatives are also discussed.

JEL Classification: Q13, Q18

Key words: food safety, food safety and quality standards, cooperative, China

1. Introduction

In recent years, China has experienced frequently food safety scares due to pesticide residue issues. Recently, the government established a nationwide food inspection and monitoring system (Wang et al., 2008), that involves recording and publicizing the quality of vegetables in 37 major cities[1] based on food standards developed by the joint FAO/WHO Codex Alimentarius Commission (CAC) international standards. As a result, the quality of vegetables increased from a rate of 82% in 2003 to 94% in 2007 in terms of being free of pesticide residues. Figure 1 provides the quality rate of vegetables in the 37 major cities from 2003 to 2007. Both food inspection and the monitoring system have contributed significantly in improving food safety in China.



Data source: Ministry of Agriculture of the People's Republic of China.

Figure 1 Quality rate of vegetables in 37 major cities in terms of pesticide residues

[1]Beijing, Changchun, Changsha, Chengdu, Chongqing, Dalian, Fuzhou, Guangzhou, Haerbin, Haikou, Hangzhou, Hefei, Huhehaote, Jinan, Kunming, Lanzhou, Lasa, Nanchang, Nanjing, Nanning, Ningbo, Qingdao, Guiyang, Shanghai, Shenyang, Shenzhen, Shijiazhuang, Shouguang, Taiyuan, Tianjin, Wuhan, Urumqi, Xiamen, Xining, Xi'an, Yinchuan, Zhengzhou.

Nevertheless, a food inspection and monitoring system that is conducted by testing the end-products is limited in its ability to assess food safety, although the rate of vegetable quality increased between 2004 and 2007, it never surpassed a level of 95%. We argue that in addition to testing, it is also important to standardize production practices of farmers because abuse of pesticide during production is often reported (e.g. Zhou, 2007). Currently, the available Chinese domestic standards in agricultural production mainly include pollution free food standards, green food standards and organic food standards with the responsible agencies of the National Agricultural Technical Extension and Service Center (NATESC), China Green Food Development Center (CGFDC) and China Organic Food Certification Center (COFCC), respectively[2]. The Ministry of Agriculture is the lead agency promoting food safety at the farm level by encouraging the adoption of domestic food safety and quality standards[3]. But, as is pointed out by Calvin et al. (2006), it is difficult to standardize production practices in a sector composed of 200 million farm households who typically have 1-2 acres of land divided into 4-6 noncontiguous plots in current China. The reasons are twofold. On one hand, most small-scale farmers can not afford the costs associated with the standard implementation (Han, 2007). On the other hand, the majority farmers are not well educated and do not fully understand the key point of the standards[4].

With the rapid development of agricultural cooperatives in China, however, the cooperatives have become the main adopters of food quality and safety standards. In fact, encouraging the adoption by agricultural cooperatives is a more practical and feasible alternative to regulations aimed at the farmers[5], because not only can the related

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[2] Although international food safety and quality controls (e.g. Good Agricultural Practices) are also available in China, they are rarely adopted by agri-food producers due to their high implementation costs.

[3] From 2008, Ministry of Agriculture is discussing plans to implement mandatory programs to encourage the adoption of the Pollution Free Standards.

[4] Zhou (2005) found that vegetable farmers in Zhejiang Province received an average education of only 5.43 years.

[5] Existing studies (e.g. Wei & Lu, 2004; Ren & Ge, 2008) stress the importance of farmer specialized cooperatives in controlling and improving the quality of food products based

costs can be shared by a group of small-scale farmers but also the production practices are organized by the cooperatives. Understanding the mechanism of the adoption of the food quality and safety standards by agricultural cooperatives[6] is of great importance in standardizing agri-food production practices in China.

The overall objective of this study is to analyze the factors that affect adoption of food safety and quality standards in China based on data from a survey of 124 vegetable cooperatives. Vegetable sector is chosen because ensuring vegetables quality is of extremely important in China as Chinese people consume a very large quantity of vegetables[7].

The remaining parts of this paper are organized as follows. Following this introduction is a literature review on food quality and safety standard adoption. The model is then introduced along with data description. Next, results and discussion are provided in section 4, followed by conclusions.

2. Related Literature

A number of studies (Holleran et al., 1999; Henson and Holt, 2000; Fouayzi et al., 2006; Jayasinghe-Mudalige and Henson, 2007) have been devoted to explore motivations of food firms to adopt food quality and safety controls[8]. In general, the existing literature reports that the adoption decisions of food businesses can not be

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on interviews to farmers and farmer specialized cooperatives in Zhejiang Province.

[6] Existing literature on the adoption of food quality and safety standards is mostly conducted in developed countries, the findings of which may not be applicable in developing countries like China.

[7] According to the Statistics of the World (2008), China, after Greece, has the second highest annual per-capita consumption of vegetables in the world. In 2003, consumption of vegetables per capita in China reached 270.49 kg compared with the average world per-capita vegetable consumption of 94.45 kg (Statistic of the World, 2008).

[8] In the existing literature, food quality and safety controls mainly refer to quality assurance systems such as Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), Hazard Analysis and Critical Control (HACCP) system, and the International Organization for Standardization (ISO) 9000 series.

attributed to government regulation alone (Henson and Holt, 2000; Fouayzi et al., 2006; Jayasinghe-Mudalige and Henson, 2007) and food firms adopt systems stemming from both internal incentives and external incentives. Internal incentives can be specified as increased benefits resulting from adoption in terms of improvements in internal efficiency (Holleran et al., 1999; Henson and Holt, 2000; Fouayzi et al., 2006; Jayasinghe-Mudalige and Henson, 2007), as well as decreased costs to the firm by minimizing product recalls (Jayasinghe-Mudalige and Henson, 2007). On the other hand, external incentives for food firms to adopt food quality and safety controls include direct requirements imposed on food firms by major customers (Holleran et al., 1999; Henson and Holt, 2000; Fouayzi et al., 2006; Jayasinghe-Mudalige and Henson, 2007) and conditions in doing business by reducing transaction costs[9] for other firms in their supply chain (Holleran et al., 1999; Fouayzi et al., 2006).

To the best of our knowledge, Herath et al. (2007) are the first to empirically analyze the association between the adoption of food safety and quality controls and other firm characteristics. Based on data from the Canadian food processing sector, they found that in general, the adoption of food safety and quality assurance practices is very closely linked to the characteristics and activities of specific food processing establishments. Firm size, industry subsector, country of ownership and control, and level of innovativeness have influences on the adoption of enhanced food safety and quality assurance practice. But the proposition that a major driver behind the adoption of enhanced food safety practices in the Canadian food processing sector is the maintenance and/or improvement of access to foreign markets is not fully supported in their study.

3. Methodology

A cooperative faces two alternatives, that is to or not to adopt any food safety and quality standards. We assume a cooperative's utility resulting from either alternative

[9] According to Holleran, et al. (1999), a product's safety and quality attributes may not be directly observable and information regarding a product's safety or quality attributes is not free. The cost of procuring this information is a transaction cost.

depends upon several attributes of the cooperative. The utility of an alternative is a function of the attributes of the cooperative, which is given by

$$U_0^* = \beta_0' X + \varepsilon_0 \tag{1}$$

where U_0^* is the utility from choosing an alternative;

X is a vector containing the attributes of cooperative;

β_0' is a parameter vector, and

ε_0 is the error term, capturing the uncertainty.

Then, the utility of adopting food safety and quality standards can be specified as

$$U_A^* = \beta_A' X + \varepsilon_A \tag{2}$$

where U_A^*, β_A', and ε_A are the utility, parameter vector and the stochastic part of adopting food safety and quality standards, respectively.

If the cooperative does not adopt food safety and quality standards, we have

$$U_N^* = \beta_N' X + \varepsilon_N \tag{3}$$

where U_N^*, β_N', and ε_N are the utility, parameter vector and the stochastic part of not adopting food safety and quality standards, respectively.

Therefore, the cooperative's net utility between adopting and not adopting is

$$\begin{aligned} U^* &= U_A^* - U_N^* \\ &= (\beta_A' - \beta_N')X + (\varepsilon_A - \varepsilon_N) \\ &= \beta' X + \varepsilon \end{aligned} \tag{4}$$

where U^*, β', and ε are the net utility, parameter vector to be estimated and the stochastic part, respectively.

As the cooperative's net utility is a latent variable, we can not observe it directly. But if $U^* > 0$, the observed choice will be the adoption of food safety and quality standards (or $Adoption = 1$) and if $U^* \le 0$, the observed choice will be the non adoption of food safety and quality standards $Adoption = 0$.

$$Adoption = \begin{cases} 1, & U^* > 0 \\ 0, & U^* \le 0 \end{cases} \tag{5}$$

If we assume the stochastic part ε follows a logistic distribution with mean 0, and a variance of $\pi^2/3$. The probabilities of $Adoption = 1$ or 0 are expressed as

$$\begin{aligned} P(Adoption = 1) &= P(U^* > 0) \\ &= P(\varepsilon < \beta' X) \\ &= \frac{1}{1+e^{-\beta' X}} = \Lambda(\beta' X) \end{aligned} \tag{6}$$

$$\begin{aligned} P(Adoption = 0) &= P(U^* \le 0) \\ &= P(\varepsilon \ge \beta' X) \\ &= 1 - \frac{1}{1+e^{-\beta' X}} = 1 - \Lambda(\beta' X) \end{aligned} \tag{7}$$

The likelihood function can be written as

$$L = \Pi \left[\Lambda(\beta' X)\right]^{Adoption} \left[1 - \Lambda(\beta' X)\right]^{1-Adoption} \tag{8}$$

The parameter vector β' in (8) can be estimated by the maximum likelihood method. The marginal effect for a variable x_i can be calculated as follows,

$$\frac{dP}{dx_i} = \Lambda(\beta' X)\left[1 - \Lambda(\beta' X)\right]\beta_i' \tag{9}$$

4. Data source and variable description

The data for our empirical study is collected from 10 cities throughout Zhejiang Province[10]. Based on a list provided by Department of Agriculture of Zhejiang Province, we sent questionnaires to 270 vegetable cooperatives in Zhejiang Province. In total, 124

[10] Actually, Zhejiang Province is made up of 11 cities, that is, Hangzhou, Ningbo, Wenzhou, Jiaxing, Huzhou, Shaoxing, Jinhua, Quzhou, Taizhou, Lishui and Zhoushan. We excluded Zhoushan city as it is an island and we do not think there is any loss in generality based on this decision.

valid questionnaires were returned during the period September 2006 to March 2007. Figure 2 illustrates the number of valid questionnaires received from each city across the province.

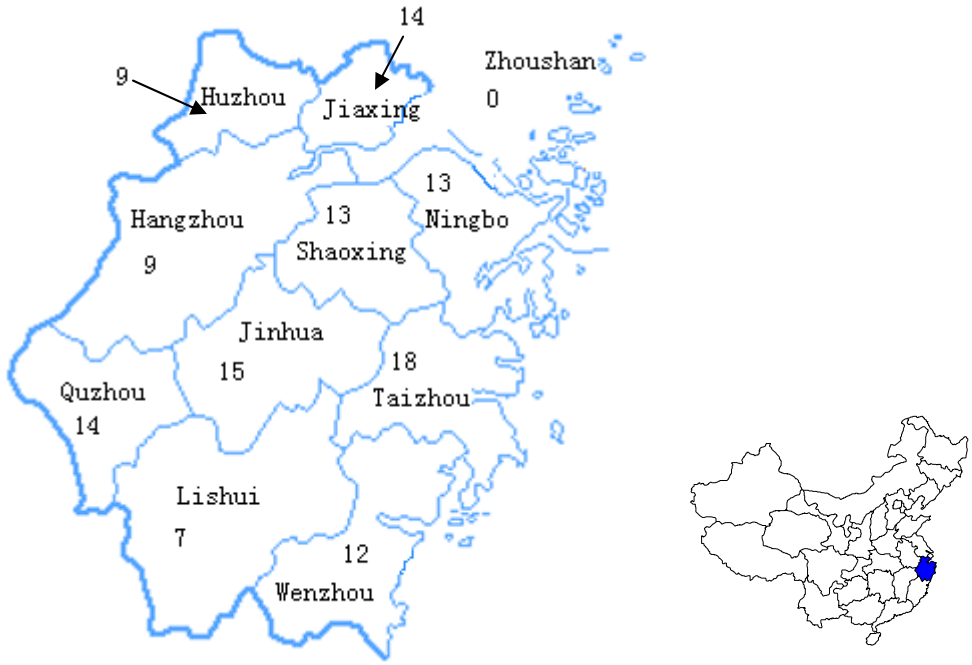

Figure 2 Valid respondents in each cities of Zhejiang Province

Table 1 lists the variables to be used in empirical analysis. The dependent variable is the dichotomous outcome of whether to adopt food safety and quality standards or not. According to the survey result, a majority (78.2%) of the vegetable cooperatives have adopted food safety and quality standards.

Table 1 Descriptive statistics of variables

		Mean	Min.	Max.	Std. Dev.
Adoption	=1if any standard is adopted, =0 if no standard is adopted	0.782	0	1	0.414
Cooperative size	Land size of cooperative (ha.)	154.160	1.33	1266.67	231.921
Innovativeness	=1 if cooperative has a homepage =0 otherwise	0.427	0	1	0.497
Perception	5 point Likert type scale from fully disagree (= 1) to fully agree (= 5) toward the statement that implementing a standard will improves the vegetable quality.	4.371	1	5	0.738
Reputation	=1 if cooperative has a brand, =0 otherwise	0.726	0	1	0.448
Cost and benefit	=1 if the expected benefit covers the cost in implementing a standard, =0 otherwise	0.589	0	1	0.494
Price premium	=1 if cooperative expected a price premium by implementing a standard, =0 otherwise	0.645	0	1	0.480
Customer attraction	=1 if standard is helpful in customer attraction, =0 otherwise	0.935	0	1	0.247
Destination market	=1 if cooperative serves supermarkets or foreign markets, =0 otherwise	0.266	0	1	0.444
Availability of support	=1 if cooperative can get support from downstream buyers, =0 otherwise	0.323	0	1	0.469

We specify the attributes assumed to affect the adoption decision as: (1) cooperative size, (2) innovativeness, (3) perception, (4) reputation, (5) cost and benefit,

(6) price premium, (7) customer attraction, (8) destination market, and (9) support[11] (see Table 1). The independent variables are specified for two reasons. First, factors appearing in previous studies are considered. By doing so, the results of those factors that could influence the adoption decisions for food and safety can be compared to those of previous studies. Second, because much of the existing literature on the adoption of food quality and safety standards has been conducted in developed countries, the findings of which may not be fully applicable in developing countries like China, we added three other independent variables. Specifically, we include (3) perception, (6) price premium and (9) support in order to better understand the adoption decision in China. The variables are explained in greater detail as follows.

(1) Cooperative size. Firm size has been identified as one of the most important to affect the adoption decision. Jayasinghe-Mudalige and Henson (2007) argued that larger firms have a capacity to implement food safety controls while most small firms showed no desire to do so. A positive sign is expected.

(2) Innovativeness. The factor of innovativeness is also used in previous studies (e.g. Herath et al., 2007). We consider whether the cooperative has a homepage or not as an indicator of innovativeness and expect a positive sign.

(3) Perception. A major barrier to adoption in developing countries may be the available knowledge on food quality and safety standard. We use a 5 point Likert scale that range from fully disagree to fully agree with the statement that implementing a standard will improve the vegetable quality to measure the respondent's perception about food quality and safety standards. A high score should lead to high probability of adoption.

(4) Reputation. Reputation will generate benefits through consumers' repeat purchases and customer loyalty. On the other hand, it will also bring about devastating losses in the event of an outbreak from a food-related accident (Herath et al., 2007).

[11] Although meeting mandatory requirement is reported as a key factor in the adoption decision in the empirical studies conducted in developed countries (e.g. Henson and Holt, 2000; Fouayzi et al., 2006;), we do not include it in our analysis because implementing food safety and quality standards is voluntary in China.

Whether the cooperative has a brand or not is used as a proxy for the effect of reputation in this paper. The expected sign is positive.

(5) Cost and benefit. In previous studies, the firm's expected benefit is also discussed as an important factor in the decision to adopt standards. For instance Holleran (1999) indicated that if the benefits of certification to a quality assurance system exceed the adoption and maintenance costs, then the standard is worthwhile. Due to the lack of educated workforce and necessary equipment required for many standards, implementing food quality and safety standards is a financial burden to vegetable cooperatives in China. Vegetable cooperatives will adopt food quality and safety standards if the expected benefit covers associated cost.

(6) Customer attraction. If the respondents view implementing food quality and safety standards as a strategy to attract new customers, the possibility of adoption will increase.

(7) Price premium. The purpose to integrate this variable into the empirical analysis is to test the hypothesis that cooperatives will make an adoption decision if cooperatives expect a price premium by implementing a standard. A positive sign is expected.

(8) Destination market. Customer pressure for higher quality and for the firms to meet standards would be expected to be greater if a cooperative serves domestic supermarkets or foreign markets. As is stated in Jayasinghe-Mudalige and Henson (2007), many supermarket chains and food service operators in North America require their suppliers to adopt specific food safety controls. The probability of adoption increases if the destination market is a supermarket or foreign market.

(9) Availability of support. As mentioned above, adopting standards is a burden for many cooperatives and in some cases downstream members may provide support to cooperatives. The adoption decision is more likely to happen when support is available.

The above nine attributes are used in the logistic model to investigate the adoption decision of food quality and safety standards by vegetable cooperatives in China. The attributes of (1) through (3) are related to cooperative characteristics, and attributes (2)

through (7) are associated with internal factors; (8) and (9) are external factors.

5. Results and discussion

Table 2 collects the statistical results of the Logistic model analysis. Generally, the model performs well, with a McFadden Pseudo R^2 value of 0.359 and log likelihood value of -41.620. In total, 86.3% of adoption decisions were correctly predicted.

Table 2 Statistical results for adoption decision

	Coefficient	Std. Error	Pr. > |z|	Marginal Pr.
Intercept	−6.713	2.043	0.001	−
Cooperative size	0.010	0.004	0.032	0.001
Innovativeness	0.076	0.592	0.898	0.011
Perception	0.934	0.448	0.037	0.137
Reputation	1.839	0.631	0.004	0.270
Cost and benefit	1.060	0.575	0.065	0.155
Price premium	0.803	0.645	0.213	0.118
Customer attraction	0.957	1.343	0.476	0.140
Destination market	1.639	0.891	0.066	0.240
Availability of support	−0.849	0.621	0.171	−0.125
McFadden Pseudo R^2		0.359		
Log likelihood		−41.620		
Correct Predictions		86.3%		
Observations		124		

First, the relationship between cooperative characteristics and the adoption decision is explored. Cooperative size, approximated by land size of the cooperative, is an important factor that affects the adoption decision as its coefficient is positively

signed and statistically significant. This result indicates that economies of size exist in the adoption of food quality and safety standards by Chinese agricultural cooperatives. A positive effect is found for the innovativeness variable measured in terms of whether or not the cooperative possesses a homepage, although its statistical insignificance is disappointing. Our result only partially supports the finding by Herath et al. (2007), which reported that innovativeness is positively associated with the adoption of food safety and quality controls in the Canadian food processing sector. A possible reason may be that the measurement in our study is different from that in Herath et al. (2007)[12].

Positive perception toward food quality and safety standards is found to be one of the most important factors affecting the adoption decision. It seems that shallow perception toward the effectiveness of food quality and safety standards in ensuring vegetable quality is a major obstacle to the adoption decision in China. The result is not an exception in developing countries, in a study on the adoption of the Euro gap standard by mango producers in Peru, Kleinwechter and Grethe (2006) reported that access to information on the standard is a major barrier in the adoption of the Eurogap standard.

Turning to the results of attributes related to internal factors. Reputation measured by owning a brand or not is the most important factor that affects the adoption decision. Based on the estimated marginal effect, the possibility of adopting a food quality and safety standard increases 27% if a cooperative has a brand. This may indicate that once a cooperative has a registered brand, it will pay more attention to the quality of its vegetables and vice versa. As expected, there was a positive and statistically significant relationship between the expected profit and the adoption decision, which agrees with previous studies (e.g. Holleran et al., 1999; Henson and Holt, 2000; Fouayzi et al., 2006). The cooperatives are rational and they will not adopt the standard if it is not worthwhile. However, to our surprise, both price premium and customer attraction do not well explain the adoption decision. A possible reason for the result is that the market for vegetables produced under standards is in chaos now as many counterfeits exist in

[12] In Herath et al. (2007), innovativeness is measured by whether food processing firms adopted at least one innovation from 1995 to 1997.

China. The cooperatives may not be able to get a price premium or attract customers by labeling food quality and safety standards.

Destination market and support from downstream members are tested as external factors. A positive and statistically significant effect is found for the destination market variable, which is approximated by whether the cooperative serves supermarkets or foreign markets. The marginal effect indicates that the possibility of adopting a food quality and safety standard increases 24% if a cooperative deals with supermarkets or exports their vegetables to foreign countries. In general, our result agrees with the previous studies by Holleran et al. (1999), Henson and Holt (2000), Fouayzi et al. (2006) and Jayasinghe-Mudalige and Henson (2007), but is not consist with the finding by Herath et al. (2007) who report that the adoption of enhanced food safety practices in the Canadian food processing sector can not fully be explained by the maintenance and/or improvement of access to foreign markets. This result may have two explanations. A positive relationship between the other external factor, support from downstream members, and the adoption of food quality and safety standards is not confirmed in out study, which may be indicate that the cooperatives are rational enough and do not implement a standard just because of the availability of support.

6. Conclusions

China has been frequently hit by food safety scares in recent years. Adoption of food safety and quality standards by China's agricultural cooperatives serves as an important approach for monitoring production practices of the numerous small-scale farmers and thus ensuring food quality in products produced by them. Based on survey data from 124 vegetable cooperatives in Zhejiang Province, the overall goal of this study was to analyze the factors that affect the adoption of Chinese domestic standards in agricultural production, namely, non-pollution standard, green standard and organic standard by vegetable cooperatives in China.

Based on previous studies, nine factors such as cooperative size, innovativeness, perception, reputation, cost and benefit, price premium, customer attraction, destination market and support are expected to affect adoption behavior by vegetable cooperatives

in China. We analyzed the effect of these factors through the use of a Logistic model. We found that cooperative size, perception toward standards, reputation, expected cost and benefit and destination market have a positive and statistically significant relationship with the adoption decision. The effects of the other factors on adoption decisions are not confirmed in our study, although expecting a price premium for having a food safety standard is in the expected destination.

Our results emphasize the importance of fostering the development of agricultural cooperatives in China, especially in terms of land size and brand registration, in facilitating food safety and quality standard adoption. Clearly, with the enlargement of the cooperative size, adopting food quality and safety standards will become more affordable for agricultural cooperatives. Also, agricultural cooperatives are likely to treat the quality of agri-food they provide more seriously once they register a brand name for their products. As such, the possibility of adopting a food quality and safety standard to ensure food safety will increase.

Another implication from our qualitative analysis is that it is also important to provide adequate information on the ability of food quality and safety standards in ensuring the quality of agri-food products to agricultural cooperatives. In a developing country like China, agricultural cooperatives may not yet fully be aware of the effectiveness of the food quality and safety standards, and this poses a barrier to their adoption decision.

Finally, our results show that although in general the cooperatives are rational enough to decide whether to adopt a food quality and safety standard or not, it seems that their adoption decision for a food quality and safety standard is not motivated by a desire to attract more customers or to get a price premium. We conclude that meeting the requirement of destination markets in order to retain access and, perhaps, maintain the market share is the main incentive for the cooperatives to adopt food quality and safety standards in China today. Our results indicated that the destination market (supermarkets or foreign markets) is one of the most important factors affecting the cooperative’s adoption decision. This result is not out line of the available literature. As

is also pointed out in Holleran, et al. (1999), a single benefit, such as satisfying a customer requirement, may be of such importance that the values of the other costs of the quality assurance system are irrelevant. This may be especially true in a developing country like China. As such, encouraging the development of supermarkets and chain store operations in the agri-food retail sector will undoubtedly improve the adoption rate of food quality and safety standards in China. Nevertheless, as is argued in Mainville et al. (2005), the mechanism of the retailers' decision to use public or private grades and standards needs to be explored in the future.

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