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Understanding farmer cooperatives' self-inspection behavior to guarantee agri-product safety in China

Jie-hong Zhou, Zhen Yan, Kai Li*

China Agricultural and Rural Development, School of Management, Zhejiang University, P.R. China

Abstract: The presence of toxic agri-products, and chemical contamination remain for the existence of smallholder farmers, who are not educated to use agricultural inputs correctly. This inability raises the issue of safety control in the agricultural sector. We proposes that cooperatives' self-inspection of agricultural products before they enter the market can better organize small farmers to utilize a standardized production and safety management system. An Ordered Logistic Regression Model is employed to estimate the factors that influence cooperatives' choices of inspection frequency. The results show that the respondents expressed a medium to high level of implementing self-inspection but a lower level of concern in testing products by batch. The regression results indicate that subjective norms, the perceived behavioral control of managers, input management, and production documentation significantly affect cooperatives' self-inspection behavior. The future implementation of safety inspection depends on the extent to which subjective norms, ability, and internal rules can improve agri-product safety in China.

*Corresponding author

1 Introduction

Pesticides and animal drug residues have a substantial effect on human health and the environment and have become an important policy issue relating to the need for appropriate quality and safety management and control policies. In China, these issues are particularly problematic because of a fragmented agricultural sector with nonstandard agricultural practices and the abuse of agricultural inputs such as additives and pesticides (Wang & Gu, 2013; Zhou, Yan & Liu, 2013b) combined with limited regulatory control over agricultural product safety (Zhong & Kong, 2013). The self-inspection system is an agricultural product safety control system that examines the chemical residues of agricultural products for sale and reports the test results to the local agricultural department. The implementation of safer self-inspections on agri-products by farmer cooperatives is not only a means to undertake greater responsibility for product quality but can also facilitate better organization among small farmers concerning the adoption of a standardized production and quality management system that improves product quality and safety (Ren, & Ge, 2008; Wei, & Lu, 2004; Yue, Zhang & Wang, 2012). Self-inspections by farmer cooperatives attempt to prevent the unqualified agricultural product distribution to the next stage of the supply chain. The Chinese government enacted the Agricultural Product Safety Law in 2006, which requires that cooperatives establish a self-inspection system that assesses chemical residues by cooperatives or third-party testing institutions. In practice, however, the development of a system of self-

inspection is at an early stage, and there is room for improvement in the self-inspection behavior of farmer cooperatives.

Currently, there is an increasing and varied body of economic analyses, public welfare, behavioral economics, and social psychology on food safety control behavior (Antle, 2001; Yang, 2006; Zhong & Kong, 2012; Zhou & Li, 2013a; Wang & Gu, 2013; Zhou Yan & Wang, 2013c). The implementation of safer agricultural production practices is often context dependent; for example, it can be influenced by macro-factors such as government intervention (e.g., sample inspection systems and punitive measures for substandard or defective products) and the degree of public attention to food safety issues. Guo & Jiang (2007) and Hu, Chen, Sun and Duo (2006) emphasized the organizational model and its influence on standard agricultural practices and product quality and safety. Zhong & Kong (2012) investigated Chinese dairy farmers and found that dairy producers had a higher level of quality and safety awareness regarding milk that was sold directly to milk processors and companies compared with milk that was sold to a middleman. However, many studies have presented exploratory findings that have suggested that a firm's quality performance is largely influenced by the "mindset" of the people who managed it. This influence suggests that more attention should be directed at individual-level factors and internal characteristics (Wang & Gu 2013; Zhou & Li, 2013a; Wang, 2013). From the manager’s perspective, the motivation for adopting testing practices for antibiotics, pesticides, and animal drug residues is more complicated to determine. Managers are

motivated not only by productivity and profitability goals but also by various subjective perceptions regarding their product quality, the external social environment, and the difficulties that farmers face in implementing safe agricultural practices.

The literature shows that subjective factors and the perceptions of managers are important in explaining the choices they make regarding food safety practices. Much of this literature focuses on the manager's risk perception of the benefits of implementing food safety practices. However, few studies systemically address the influence of a cooperative decision maker's subjective norms, perceived difficulties of behavior control on adopting food safety practices, and the implications for public policies. Moreover, the frequency of testing, various agricultural products, and cooperative rules that are established by managers are also key issues that vary among managers. However, heterogeneities in the practices that are adopted by managers of cooperatives are not often characterized and evaluated in the literature.

Therefore, we examined cooperative managers' preferences and perceptions regarding their decisions to implement testing of their agricultural outputs to better understand the incentives for the adoption of self-inspection systems based on the theory of planned behavior (Ajzen & Fishbein, 1980). To obtain an overview on the current inspection conditions, four levels of quality testing including non-self-inspection (NonSI), occasional self-inspection (OccaSI), periodic self-inspection (PerdSI) and batch-based self-inspection (BybatchSI) were introduced. Our objective was to

uncover the cause of the discrepancies among the four levels of Chinese cooperative managers' self-inspection behaviors.

2 Theoretic Framework

Before examining the underlying determinants of cooperative managers' self-inspection behavior, we first needed to gain insight into how this behavior works. Ajzen & Fishbein (1980) initially developed the reasoned action theory and proposed that human action directly depends on behavioral intention, which is generally influenced by individual attitudes and subjective standards. Ajzen (1991) further introduced the variable of perceived behavioral control to the previous behavioral framework and developed planned theory. This theory defines human action as a combination of three dimensions, namely, behavioral beliefs, normative beliefs, and control beliefs. Normative beliefs refer to subjective norms or perceived social forces (i.e., expectations of customers, consumers, competitors, regulators, etc.). Control beliefs refer to perceived behavior control that alters individual perceptions of the degree of control on an action, which is similar to self-efficacy. In recent research, perceived behavior control has been demonstrated to depend somewhat on an individual's past activities. Ajzen (2002) integrated past behavior to explain its effect on behavior intention and behavior. Olander & Thogersen (1995) argued that ability was also a good predictor of behavior because the consistency between motivation and behavior could only be achieved under conscious control. Moreover, a

consideration of the influence of different individual characteristics should also be included (Lobb *et al*., 2006; Mazzocchi *et al*., 2008).

2.1 Cooperative managers' self-inspection behavior in Zhejiang

In early 2004, the government of Zhejiang Province emphasized the promotion of standardized production through specialized cooperatives. This government required that capable, specialized cooperatives initiate self-inspection and self-testing focused on the construction of rapid tests and quarantine inspection systems for product quality safety. For the managers of cooperatives, the self-testing may analyze pesticide and drug residues from the input of additives and raw materials. This self-testing can help to improve managers' awareness of a product's present condition from his/her own and other members' farms before these agri-products are sold either to the markets or downstream to customers by the co-ops. Once testing values exceed the normal limit, managers could organize producers and other members to adjust their practices (i.e., extend the withdrawal time) to avoid possible economic and reputational loss from safety problems in the market.

Generally, there are two different ways for cooperatives to conduct chemical residue testing: either by the cooperative or by an independent (often government or government-sanctioned) testing agency. Testing by the cooperative requires that its manager build a laboratory or purchase rapid inspection equipment to test illegal drug and pesticide residue levels. Testing by an independent agency is always conducted

by an organization or some leading cooperatives that have testing certification and are entrusted by the cooperative customers to evaluate their agri-product safety. These inspections cost money. An agricultural self-inspection system, with agricultural traceability systems, information management systems, and production documentation management, is an important part of the agri-product safety traceability system (XCNEWS, 2012) to trace back product quality by batch number. Zhang (2010) pointed out that inefficient traceability system and the absence of penalizing measures on non self-inspection, leads the managers to fall into a prisoners' dilemma trap.

The motivation for self-inspection behavior comes from an internal perception and awareness of the external environment and from the specialized cooperatives' need to lower the uncertainty of quality and safety under different levels of quality control by implementing self-inspection in a collective manner (i.e., not separately conducted by each individual farmer). This is because specialized cooperatives have limited capabilities to control the safety of agricultural products when farmers implement standardized and safe production.

2.2 Hypotheses proposed

China's specialized farmer cooperatives are at the initial developmental stages of organizational structure and governmental regulations. Most co-ops are established by large farms, enablers of agricultural production, or managers in leading agri-

businesses. In China, a manager of a cooperative, as one member in a co-op, is responsible for organizing other members who are mostly small and dispersed farmers. These farmers sell their agri-products together to enter large markets that have strict requirements on standardized production, although these farmers do not rely on a single brand. This organization leads to cooperative activities and institutional arrangements that are largely influenced by the managers of the cooperatives (Bai, 2010; Huang, 2012, p64-69). Thus, the implementation of self-inspection systems by cooperative managers is suitable to consider the general theory of individual decision-making behavior. This study proposes that a manager's safety awareness, ability to control safety, and internal rules on production have direct effects on his/her self-inspection behavior.

2.2.1 Subjective norms

To improve producers' awareness of product safety, many governments promulgate related laws and regulations, including providing safety standards, extending sample testing coverage, and executing market access systems (Loader and Hobbs, 1999; Hobbs, 2003; Udith Krishantha, 2004; Zhou *et al*., 2011). Group consistency in social standards forces individuals to behave similarly to other individuals in the same group (Wang, 2013). Karshenas & Stoneman (1993) proposed that the number of adopters (stock effect) and the firm's position in the order of adoption among competitors (order effect) can influence the expected profit gain from adopting a new technology. Herath, Hassan & Henson (2007) outlined a conceptual framework that indicated that

a manager's incentives (such as meeting legal requirements) and her/his responses to customer pressure were important in considering the adoption of new technologies to enhance food safety and quality in Canada. In the agricultural industry, Zhou *et al*. (2013c) noted that the social norms in China's export-oriented aquatic firms could be explained through public awareness of food quality and safety, peer competition, and customer pressure. Thus, the following hypotheses are postulated. (H1a) *The perception of regulatory requirements concerning agri-product quality and safety is associated with the* self-inspection frequency in testing agricultural products. (H1b) *The public's awareness of food safety and quality* increases the self-inspection frequency in testing agricultural products. (H1c) *Peer competition* increases the self-inspection frequency in testing agricultural products. (H1d) *Customer pressure with regard to safety and quality* increases the self-inspection frequency in testing agricultural products.

2.2.2 Perceived behavior control

Individual behavior is somewhat subjective with regard to task complexity and difficulty (Bandura, 1977). Basically, when a manager faces greater difficulty, he/she will intentionally avoid the task. Jin, & Zhou (2011) directed attention to the food safety problems that have been caused by excessive pesticide residues in recent years and discussed effective ways to organize safe production and quality standardization through specialized farmer cooperatives. According to the theory of principal-agent, the manager of the cooperative should supervise the behavior of the farmers whose

products are sold to co-ops to reduce the moral risks that arise from the asymmetry of quality information (Liu & Zhang, 2014). This theory implies that quality and safety control behavior is initiated in the cooperative. However, Jia & Huang (2011) argued that member heterogeneity in cooperatives could influence managers' decision-making. Cooperative managers generally attempt to repeatedly estimate the level of quality of the products from different farmers and then decide what level of quality inspection they should adopt. Currently, most studies have not considered the co-op manager's perception of the control difficulties faced by farmers. Therefore, the following hypotheses are postulated in our paper. (H2a) The realization of *farmers' unawareness of food safety and managers' weak agricultural practices has* a negative relationship with the self-inspection frequency in testing agricultural products. (H2b) A manager's *perceived difficulty from farmers who implement standardized techniques* has a negative relationship with the self-inspection frequency in testing agricultural products. (H2c) A manager's *perceived control difficulty from small-scale production* has a negative relationship with the self-inspection frequency.

2.2.3 Ability

A manager's ability to perform his/her intention is the third component of the model. Social norms and perceived behavior control lead to performance of the behavior only if the manager reaches the required ability. Thøgersen (1995) further examined whether the ability concept could be explained by the knowledge of the task. The manager's knowledge regarding the ways to reach his/her goal (e.g., how to identify

residue sources correctly) may be faulty. In self-inspection programs, deficient task knowledge may lead to additional input management.

Cooperatives provide an effective approach to link many small farms to a larger market, which motivates farmers to participate in good agricultural practices. The number of quality technicians and a unified input management are also critical to cooperative quality and safety assurance systems. Unified input management has been widely accepted, and co-ops purchase most goods and agricultural inputs that are used in agricultural production. This will help cooperative managers gain more information regarding materials from the input of farmers and prevent the use of illegal chemical inputs, which lowers the quality and increases the safety risk of agricultural products. Using aquaculture as an example, Fang, Wang & Hu (2006) and Zhou *et al*. (2013c) proposed that adopting an enhanced product safety and quality control practice required the human capital of quality inspection, material resources, and research. Therefore, we postulate the following hypotheses. (H3a) A larger *number of quality technicians* in a cooperative is related to the manager's self-inspection behavior in testing agricultural products. (H3b) The ability of *unified agricultural input management* is associated with the level of self-inspection in testing agricultural products.

2.2.4 Internal rule

The internal rule on production plays an important role in regulating and monitoring producers to provide safe and quality products. Hobbs (2003) examined the factors that drive changes in the agri-food sector concerning food safety and quality assurance. In the study, external shocks changed the internal nature of safety management, which led to institutional adaptation. The regulation on the self-inspection of agri-product residues changed the liability incentives for upstream sectors of the agri-product supply chain, which made producers, such as those who lead cooperatives, potentially liable for the safety of products. Prior to the change in this law, cooperatives and firms could rely on downstream customers or supervisor's sampling tests to verify their products' safety and quality. Under this new rule, cooperatives must show that they have organized farmers and monitored the safety and quality of their products. Zhou *et al*. (2013a) noted that monitoring and record-keeping requirements related to food safety act as an internal rule for organizing farmers to engage in safe production. Farmers intended to estimate the safety and quality of the products that they produce by examining the product records and agricultural inputs that are used in production. In turn, farmers demanded more intensive testing for product quality as a defense in the event of a safety problem that can be traced back to farmers. Thus, we postulate the following hypotheses. (H4a-H4c)

The production record, the interaction between the production record and its traceability to farmers, and the interaction between the production record and the

ability of unified agricultural input management have a positive relationship with a manager's self-inspection frequency in testing agricultural products.

3 Methodology

3.1 Data collection

Zhejiang is the first province to establish specialized farmer cooperatives and to introduce local regulations in China. These efforts contributed to Zhejiang's leadership on cooperative development in China and showed its concern for agricultural product safety and quality. Before sampling, pre-surveys were conducted in March 2013. Five chairpersons from each farmer cooperative were interviewed to discuss our questionnaire, and several items were revised based on their responses. A provincially representative survey based on a quota sampling of 15-20 farmer cooperatives in every county from each city was conducted. A total of 900 cooperative managers were interviewed through face-to-face interviews, in-cooperative interviews, or email from April to October 2013. This investigation was arranged by the Agriculture Department of Zhejiang Province and completed by graduates from the Agricultural Economic Management program of Zhejiang University. According to the Zhejiang Province Statistic Yearbook (2009-2012) and statistical results from the Zhejiang Province Ocean and Fisheries Bureau (http://www.zjoaf.gov.cn), the interviews with co-op chairpersons were conducted only in one county in Zhoushan and Ningbo City for two reasons. First, marine

fishing in Zhoushan City is the major industry for which safety control is outside the scope of agricultural sector regulation. Second, the aquaculture industry of Ningbo City is directly under the supervision of the Center government. A database that comprises 784 farmer cooperatives of fresh agricultural products, including fruits, vegetables, livestock, grain and oil, and aquatic products, was obtained. Fig.1 displays the number of valid questionnaires that were obtained from each prefecture across Zhejiang Province.

[Insert Fig. 1 here]

3.2 Sampling

The average age of the cooperative managers was 47.04 and ranged from 18 to 78 years old. The managers who had attended high school accounted for 45.3% of all cooperative managers, followed by people who had obtained a bachelor degree or above (24.1%). This result represents an improvement in the cooperative manager's educational level and is far better than the educational level of the average small farmer, who has only an elementary school background in China. In our survey, out of all the cooperatives, 60.6% were fruit and vegetable cooperatives, 10.7% were livestock cooperatives, and 12.9% were grain/oil cooperatives. This finding was consistent with the industry distribution characteristics in Zhejiang. The number of aquatic product cooperatives only accounted for 3.6%, which demonstrates a lag of cooperative construction in this industry and is in contrast to the major aquaculture

province in China. Because Zhejiang Province was chosen as the pilot of cooperation development in 2003, the number of cooperatives that were funded after 2004 reached 686, which accounted for 87.5% of all sample cooperatives. The functions of Chinese farmer cooperatives include farming, processing, and marketing. In our survey, all of the cooperatives were involved in agricultural production, and 85.84% of them were pre-processing cooperatives (54.97% were involved in product grading, 63.65% were involved in product packaging, and 17.35% had cold storage for produce). There were 487 cooperatives involved in selling agricultural products, and 432 cooperatives were involved in both pre-processing and marketing.

3.3 Data analysis and Measures

Applied studies based on the theory of planned behavior (TPB) have used a variety of methods to estimate the relation between behavior and its determinants. We followed the method used in Cook Kerr, & Moore (2002) and Mazzocchi, Lobb, Traill & Cacicchi (2008) to estimate a theoretical model on an ordered discrete-choice model. We chose an ordered logistic regression model because the categorization of a manager's self-inspection behavior is measured using a discrete measurement method, which suggests avoiding regular testing numbers of products from different subsectors.

An n-category ordered logistic model was used in this study and is defined as

$$\log\left(\frac{p_i}{1-p_i}\right) = \alpha + \sum \beta_i X_i + \varepsilon_i, \quad i=1, 2, \ldots n \qquad (1)$$

In Equation (1), p_i is the probability of being assigned to one type of frequency of self-inspection behavior if the *i*th cooperative manager made the self-inspection choice. X_i is the independent variable, β_i is the parameter, α is the constant, and ε_i is the random error.

The categorization of a manager's self-inspection behavior is measured with a discrete testing period. A cooperative manage would decide how often quality testing he/she takes, depending on the growing period and season differ among products. The frequencies of pesticide residues testing are applied to measure agri-product quality inspection behavior. First, occasional self-inspection (Occa SI) is referring to these managers who take product pesticide residue testing only once or twice during the whole growing cycle, and also including whose products are tested from sampling inspection by the agricultural departments. It is thought to be lowest level of self-inspection. Second, periodical self-inspection (Perd. SI) is largely accepted as once or twice testing during each growing season. Third, batch-based inspection (Bybatch SI) before sale for each batch or lot, is taken as the highest level of residues testing behavior. Four levels of agricultural product self-inspection are therefore distinguished based on the frequency of inspection that a coop manager adopts. Denote the value of agricultural product self-inspection to be 0, 1, 2, 3 if a cooperative manager adopts none, occasional, periodical, or batch-based self-inspection, respectively.

3.4 Independent variables and measurements

The survey explored managers' general characteristics for conducting agricultural product safety and quality control. Accepted measures from psychology and the internal rule were used to examine the hypotheses' relation, as previously discussed, with adjustments to the wording to capture the context of self-inspection behavior.

The model encompasses five latent variables that were measured as follows. Subjective norms in the self-inspection system were examined with the following four measures: the perception of the government requirement and exposure; the perception of consumer awareness of food safety and quality; the pressure from peer competition; and customer attention to product safety and quality. These measures are described in Table 1. The perceived behavior control was determined with a five-item Likert scale that measures a co-op manager's perception difficulties on the following three items: the farmer's unawareness of product safety; unstandardized techniques; and small-scale production. According to Zhou *et al*. (2011), ability was examined with two measures, namely, the number of quality technicians in the cooperatives and unified input management. Finally, three items that measure the internal rule by managers of cooperatives (the production record, the interaction of the production record and traceability, the interaction of the production record and unified input management) were implemented in this study. In addition, social demographical factors (i.e., age, educational background, number of farmers) were included.

[Insert Table 1 here]

4 Results

4.1 Cooperative manager's self-inspection behavior

Overall, there were 526 cooperative managers that implemented self-inspection, which accounted for 67.18% (See Fig. 2). This result demonstrates that managers expressed a medium to high level of willingness to implement self-inspection in general; however, they demonstrated a lower level of concern in testing products by batch (19.03%). Among those managers who chose self-inspection, 75.80% entrusted professional branches or third-party institutions to conduct product quality testing to ensure product quality that is compliant with relevant national specifications. Approximately 43.86% of the cooperatives adopted inspection by building a testing lab or by buying rapid auto-analyzers.

[Insert Fig.2 here]

In the transformation of agricultural modernization, the cooperative manager faces pressure from agricultural production standardization and technical extensions; thus, the number of farmers largely depends on a cooperative's quality control behavior. The average number of farmers in the cooperatives was about 376, which is higher than what is generally acknowledged. However, the number of cooperatives with less than 50 farmers accounted for 34.8% of the overall population, which indicates that most cooperatives include a small number of farmers. The number and percentage of cooperatives with farmers in four categories of different frequencies of self-inspection

are shown in Table 2. The percentage of non-self-inspection in the cooperatives with less than fifty farmers was nearly double the percentage of non-self-inspection in other cooperatives. In the transformation of agricultural modernization, the cooperative manager faces pressure from agricultural production standardization and technical extensions; thus, the number of farmers largely depends on a cooperative's quality control behavior. We further assessed this discrepancy of the determinants of interest between two cooperative categories.

[Insert Table 2 here]

4.2 Measurement Model

The regression results from the ordered logistic model of the total sample (Model 1) and a sample of less than 50 farmers (Model 2) for implementing self-inspection was estimated using SPSS 17.0 and is presented in Table 3. The F-value of the adjusted Wald test for goodness of fit was significant at the 1% level in both models. In addition, the results showed that manager characteristics were closely associated with the intensity of adoption. All the coefficients were statistically significant.

[Insert Table 3 here]

4.2.1 Subjective norms and self-inspection behavior

The perception of the regulatory requirements and exposure is not significantly associated with self-inspection in models 1 or 2; see in Table 3. Next, although the hypothesized relation between the public's awareness of food safety/quality and self-

inspection behavior was confirmed in model 1, it was rejected in Model 2. The relationship between the pressure from peer competition and self-inspection frequency was corroborated for the total sample but not for Model 2. This result suggests that cooperatives with less than fifty farmers are not sensitive to market competition fr*om peer competitors to improve product quality control*, whereas the total sample with more farmers is sensitive to this market competition. The results from both models indicate that customer pressure on safety and quality had a positive and significant impact on self-inspection behavior. The pressure from the social environment improves managers' awareness and thus encourages their self-inspection behavior with regard to product safety. Moreover, many pesticide testing points have been established by the government in supermarkets and wholesale markets, and residents may go there to obtain product safety information for free. This convenient testing method may backward incentivize producers, including peer competitors and customers at each stage of the supply chain, and ultimately increase the agricultural producers' safety inspection behavior to guarantee their product before it enters the market.

4.2.2 Perceived behavior control and self-inspection behavior

Unexpectedly, the results show that the realization of farmers' unawareness of food safety and weak agricultural practices have no significant relation to self-inspection frequency in testing agricultural products for either model. This result suggests that managers' perception of farmers' awareness of food quality was not an important predictor of self-inspection

behavior. Although *a manager's perceived difficulties from implementing standardized technology significantly influence self-inspection behavior* was confirmed in Model 1 (see Table 3), it was rejected in m

Model 2. As theorized, the coefficient for hypothesis H2c was significant for both models, which indicates that a manager's perceived difficulty in scaled production negatively influenced his/her intent to adopt batch-based self-inspection. This finding reveals that a higher degree of perceived difficulty in scaled production tends to lower a manager's self-inspection intensity in testing chemical residues in agricultural products. This tendency suggests that an increase in the difficulties of perceived behavior control decreases the probability of implementing self-inspection intensity. The difficulties associated with farmers' implementation of standard instructions for production and scaled production have negative and pronounced effects on a manager's self-inspection behavior. This finding indicates that when a manager decides to implement frequent self-inspection practices, he/she would first estimate the safety level of the products. Once a manager encounters difficulty in executing agricultural product safety control during production, he/she would avoid worse results that are generated by testing. This result confirms the prediction of self-efficacy to individual behavior. Managers perceived that they had some difficulty in improving product quality and safety because of small-scale production, and this difficulty did not lower the frequency of self-inspection. This result indicates that managers in small-scale cooperatives had a low level of adoption of production standardization and in particular, low participation levels in developing particular technical standards (10.3%).

4.2.3 Ability and self-inspection behavior

The results from both models indicate that the *number of quality technicians* in a cooperative had a positive and profound impact on self-inspection behavior, which supported H3a. Unexpectedly, the c*ooperative's ability of unified agricultural input management* had pronounced but negative effects on implementation activities. A possible explanation is that a cooperative manager can reduce illegal fertilizer or pesticide use by purchasing goods for farmers and, in turn, lower the safety risk of agricultural products. In China, no goods registration and regulation system is in place to monitor the distribution of agricultural inputs (goods). It is easy for individual farmers to buy illegal and inferior inputs (goods and materials for production) from small outlets, which cause possible pesticide residues and heavy metal content. However, cooperatives are capable of directly negotiating with large-scale manufacturers and of buying these manufacturers' agricultural inputs, such as fertilizers, pesticides, seeds and feeds. This arrangement helps co-ops and farmers to obtain the qualified safety of these inputs as required by the relevant laws and regulations. Therefore, cooperatives can purchase agricultural materials for farmers in a unified way, and they have a better safety control level and a lower frequency of self-inspection.

4.2.4 Internal rule and self-inspection behavior

The rule of *production record* is not associated with self-inspection frequency in either model. The current findings provide strong support for the hypothesized relation between interaction and self-inspection behavior for both models. The results from both models indicated that the interaction between the *production record and*

ability of unified input management of cooperatives had a positive and profound impact on self-inspection behavior. One possible reason is that production records and traceability back to farmers will improve the accuracy of preventing safety problems and thus will increase self-inspection intensity.

Manager characteristics have significantly positive influences on self-inspection behavior. The results implied that older managers tended to be more inclined to adopt self-inspection, which does not accord with previous producer safety and quality control studies (Yang *et al*., 2010). This finding also suggests that educational background is an influential factor in adopting self-inspection.

5 Conclusions

As a rapidly growing sector in China, agricultural products attract much attention regarding quality and safety control because of the increasingly serious effects of chemical residues on human health. This study empirically investigated the factors that influenced the adoption of self–inspection behavior for agricultural products before they entered the markets; this investigation was conducted using a database of 784 cooperative managers in Zhejiang Province. The descriptive results showed that approximately one-third of managers performed no self-inspection. Among the remaining managers, three-quarters of them entrusted professional branches or third-party institutions to conduct product safety testing. This result indicates that a low percentage of cooperative managers had actually implemented medium to high levels

of self-inspection. The results from a logistic regression of the sample with the total sample indicate that factors such as public awareness of food safety, peer competition, and customer pressure on safety and quality can incentivize and influence the level of self-inspection that is adopted by cooperative managers. The perception of standard text adoption, scaled production, the number of quality technicians, unified input management, and the production record with traceability back to the farmers are interaction variables that can also influence the self-inspection behavior of managers. In contrast, for the regression model of the sample with less than 50 farmers, factors such as public awareness, peer competition, and the perception of standard test adoption had no significant relation to self-inspection. Other factors such as government supervision and the production record had opposite influences on self-inspection behavior.

From these conclusions, we identify the following needs and recommendations to improve policy and standards to incentivize safety inspection by cooperative managers in the process management system.

Based on the perception that subject norms can cause a higher awareness of food safety, it is important to educate the public regarding pesticide residues and safety inspection qualification. Consumer's recognition of pesticide residue can improve their willingness to pay for safe products, which leads to healthy competition in the agricultural sector. Consumer recognition can also provide a market driving force that incentivizes customers to request safety testing documents and ultimately increases

the intensity of self-inspection on the products of cooperative managers. Our findings suggest that a manager's participation in establishing or adjusting agricultural standards is essential to decrease the difficulty in the perception of the behavioral control on farmers.

Moreover, it is necessary for managers to encourage quality technicians to strengthen safe production training and to adjust formal product standards to standards that are suitable for farmers in practice. An alternative function of the cooperative manager is to purchase and sell agricultural inputs to farmers. This function helps to lower the cost of institution implementation and service provision by the cooperatives compared with market channels. Because of the cost savings of production inputs, farmers will be more willing to provide safer products to the cooperative.

Finally, additional support is required to encourage construction of the internal safety rule and a supervision system such as production documentation and traceability. These two systems incentivize the implementation of self-inspection on producers by monitoring both farmers and managers. From the perspective of policy makers, small-scale cooperative managers should direct more attention and support to establishing standardized and regulated internal rules to improve self-inspection of agricultural products before they enter the markets.

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Table 1. Variable descriptions

Variables	Description of variables	Mean	S.E.
Self-inspection (SI)	If manager implement non SI=0；if occasional SI=1；if periodical SI =2；if batch-based SI =3	2.399	1.131
Subjective norms			
Gov. requirement	The requirement and exposure regarding food safety are strict. (1=extremely disagree, 5=extremely agree)	3.96	1.070
Public awareness	Perception of consumers' improved awareness of food safety (1=extremely disagree, 5=extremely agree)	4.53	.727
Competitor pressure	Pressure from peer competitor' adoption of food safety control system (1=extremely disagree, 5=extremely agree)	4.35	.922
Customer pressure	Pressures from customer's close attention to product safety and quality (1=extremely disagree, 5=extremely agree)	3.94	1.064
Perceived behavior control			
Farmers' unawareness	*Perceived farmes' unawareness of food safety and weak agricultural practice* (1=extremely disagree, 5=extremely agree)	4.24	.745
Standardized technique	*Perceived difficulty from implementing standardized technique* (1=extremely disagree, 5=extremely agree)	4.04	.870
Small-scaled production	Perceived difficulties from implementing scaled production (1=extremely disagree, 5=extremely agree)	4.14	.870
Ability			
No. quality technicians	Number of quality technicians in cooperatives	2.25	4.155

Unified input mang.	If manager purchases agricultural inputs together for farmers=1; others=0	.69	.461
Internal rules			
Production rec.	Farmers have to provide production records=1; if others =0	.79	.411
Production rec.*Traceable	Farmers have to provide production records and can be traced if product has safety problems=1; others =0	.56	.497
Production rec.* Unified input mang.	Farmers have to provide production records and purchase input from cooperative=1; others =0	.60	.490
Controlled variables			
Age	The age of cooperative manager	47.04	8.287
Educ. background	Manager owning a primary school level or below =1； junior school=2;Senior or vocational school=3; High school or above=4	2.86	.878
No. of farmers	<50 farmers =1; 51-200 farmers =2; 201-1000 farmers =3; 1001 or above farmers =4	2.06	.939

Table 2. The Intensity of self inspection by number of farmers

No. farmers in Coops.	Non SI	Occa. SI	Periodical SI	Batch-based SI
<=50	124(45.4%)	28(10.3%)	80(29.3%)	41(15.0%）
[51-200]	62(25.8%)	33(13.8%)	89(37.2%)	55(23.0%)
[201-1000]	58(26.2%)	37(16.7%)	86(38.9%)	40(18.1%)
>=1001	13(26.0%)	7(14.0%)	17(34.0%)	13(26.0%)
Total	257(32.8%)	72(13.4%)	231(34.7%)	146(19.0%)

Table 3. Ordered Logistics regressions for total sample and selected sample

Variables	Model 1 (Total sample)		Hypothesis tested	Model 2 (<50 farmers)		Hypothesis tested
	Value	Wald		Value	Wald	
Gov. requirement	.052	.552	*Rejected*	-.031	.050	*Rejected*
	(.070)			(.139)		
Public awareness	.295**	6.169	*Confirmed*	.323	2.087	*Rejected*
	(.119)			(.224)		
Competitor pressure	.206**	5.081	*Confirmed*	.195	1.078	*Rejected*
	(.091)			(.188)		
Customer pressure	.411***	25.730	*Confirmed*	.863***	24.210	*Confirmed*
	(.081)			(.175)		
Farmers' unawareness	-.070	.375	*Rejected*	-.004	.000	*Rejected*
	(.115)			(.225)		
Standardized technique	-.230**	4.435	*Confirmed*	-.340	2.255	*Rejected*
	(.109)			(.227)		
Small-scaled production	-.239**	5.851	*Confirmed*	-.489**	5.727	*Confirmed*
	(.099)			(.204)		
No. of quality technician	.048*	3.533	*Confirmed*	.371***	11.289	*Confirmed*
	(.026)			(.110)		
Unified input mang.	-.853***	6.665	*Rejected*	-1.426**	4.893	*Rejected*
	(.330)			(.645)		
Production rec.	-.138	.229	*Rejected*	.195	.141	*Rejected*
	(.288)			(.519)		
Production rec.*Traceable	.706***	15.685	*Confirmed*	.808**	5.781	*Confirmed*
	(.178)			(.336)		

Production rec.* Unified input mang.	.644*	2.902	*Confirmed*	1.255*	2.966	*Confirmed*
	(.378)			(.729)		
Age	.019**	4.267		.031*	2.879	
	(.009)			(.018)		
Educ. background	.256***	8.146		.376**	5.045	
	(.090)			(.167)		
No. of farmers	.070	.765		—	—	
	(.080)					
F-value	139.04***			106.28***		

Note: ***, **, and * denote confidence level of 99%, 95%, and 90%, respectively; () represents Standard deviation.

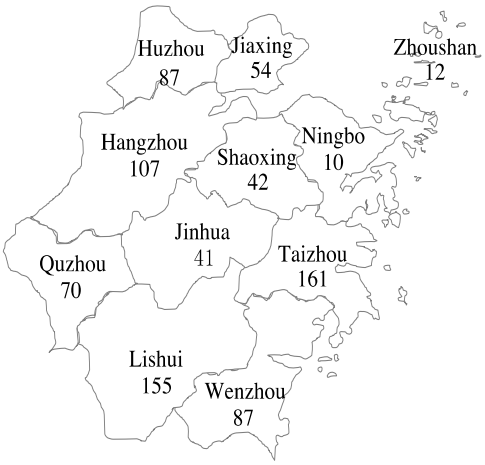
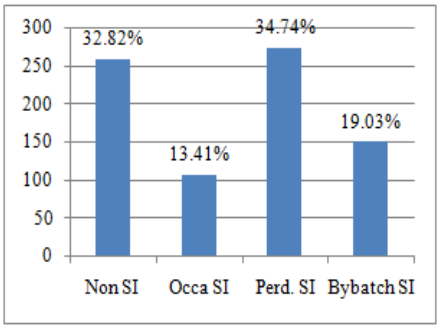


Fig.1 **Valid respondents from each prefecture in Zhejiang Province.**



Note: Non SI represents non self-inspection; Occa SI represents occasional self-inspection; Perd. SI represents periodical self-inspection; and Bybatch SI represents batch-based self-inspection.

Fig. 2 Self-inspection Frequency