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## Article

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## **INNOVATIVE SOLUTIONS IN TRACEABILITY TO IMPROVE THE COMPETITIVENESS OF A LOCAL FRUIT AND VEGETABLE RETAILING SYSTEM**

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### **Abstract**

The aim of the research is to investigate the network of local fruit and vegetable products from “farm to fork”, to uncover the hidden processes in traceability and to advise innovations in the retailing system to improve the competitiveness of the sector. Traceability is an ability to track any food that will be consumed throughout the processes of production, processing and distribution. The research investigates what the customer knows about the origin and treatments of purchased products and what further information would satisfy the consumer. The study explores the flow of information amongst the chain members: producers, wholesalers, small-scale retailers, and customers. Based on interviews and questionnaires, regression analysis and ordinal regression procedure were performed. Innovative solutions to make the retailing competitive should be aligned with the precise knowledge of the consumer. The results of the research show that deficiencies in data collection, data erosion, low level of cooperation of supply chain partners, not paying more attention for more detailed information, and inadequate control are the main problems of the traceability in fruit and vegetable chains.

**Keywords:** retailing, competitiveness, innovation, traceability, local fruit and vegetable supply chain

**JEL Classification:** M39

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### **Introduction**

Global supply chains in the fruit and vegetable industry have been developed recently however the importance of locally produced products increased greatly (Feldmann and Hamm, 2015). Purchasing locally produced fresh fruits and vegetables is getting popular

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in many areas, generally people trust better locally produced foods than products originated from long supply chains (Rikkonen, et al., 2013).

The purpose of the paper is to examine the local fruit and vegetable retailing system determining the local supply chain members, investigate their contribution to a reliable and safe fruit and vegetable supply and identify the expectations of the final consumers in the locality of Debrecen. Data were collected by questionnaires and interviews from the producer to the final consumer.

The modern customer is more demanding and conscious especially when they buy food products (Perrea, Grunert and Krystallis, 2015). The quality of fruit and vegetable products is determined by the activities of supply chain members from the producers through retailers. Therefore the traceability of food products has become a significant factor to have a safe and healthy food supply. In order to understand the processes in the supply chain all the activities of the chain members should be investigated to determine the gaps in the flow of information.

Analysing the flow of information through the local fruit and vegetable retailing the erosion of data was experienced, loss of information in the supply chain. Although the final customer wants to have more information about the fruits and vegetables they do not intend to pay more for the product to have better knowledge about it.

Our paper is organized as follows. In the literature review we synthesize the knowledge about the food traceability on the local markets and the food supply chains. The methodology section demonstrates the circumstances of the research. Interviews and questionnaires were used to collect data, and regression and ordinal regression were performed for data analysis. In the results and discussion part of the article the characteristics of traceability were identified from the aspect of consumers, small-scale retailers, wholesalers, and producers. Then vertical relationships in retailing is discussed. Finally in the conclusion chapter the main findings are presented with respect to the hypotheses.

## **1. Review of the scientific literature**

Consumers have many expectations (e.g., quality, price, origin) toward a product which should be taken into account to manage a competitive retailing system (Jin and Zhou, 2014). Innovative solutions in food traceability may help to increase the sales of foods globally and locally.

Research conducted in four EU countries showed that consumers associated traceability with health, quality, safety, and control, and that all these elements increased consumer confidence (Rijswijk, et al., 2008). The food retailers have to adapt itself to the customer's changing demands and, they have to make efforts to make their costumers return to the store, and purchase again (Dabija and Babut, 2012).

Checking the origin and the quality of a food's origin requires the use of innovative tools to monitor food quality. Förstel (2007) suggests the use of IRMS (Isotope Ratio Mass Spectrometry) to test food authenticity. Buyers prefer to purchase food with known history over the purchase of foods with uncertain origins; nevertheless, consumers do not wish to pay much higher prices for their food items of documented origin. Still, people buy more food products if they know the history behind their food (Choe, et al., 2009). European consumers have become more sensitive to the quality and traceability of food, mainly because

of recent food-transmitted diseases, such as BSE (Bovine Spongiform Encephalopathy) and swine flu. Because of regular food recalls, producers would like to have sensitive, real-time testing methods for food safety assurance (Vorst, 2006).

An important aspect of managing traceability in retailing is to collect and store data on the history of food products. Eco-labelling of food products contributes to a better understanding of the life cycle of a product (Dinu, Schileru and Atanase, 2012). Peets, et al. (2009) suggest the RFID (Radio Frequency IDentification) tag “as the most appropriate storage systems”. Alphanumerical codes, bar codes and RFID were studied to clarify the most appropriate methods of traceability of Parmigiano Reggiano cheese and to quantify the costs of different traceability methods (Regattieri, Gamberi and Manzini, 2007). To overcome the problems associated with the identification of the origin of locally produced crops; Sato, et al. (2007) developed a method of checking the origin of vegetables of doubtful origin by using trace elements to determine their producer.

Traceability is increasingly becoming a competitive advantage for enterprises in the food business. Buyers impose stricter rules on the supply chain (SC) members than the mandatory national rules. Particular commercial organisations require SC members to use traceability control systems. Diogo, Monteiro and Caswell (2005) found that the EurepGAP, which certifies traceability, enabled the Portuguese pear industry to be accepted on the UK market. A precise traceability system gives an improved feedback to the producer (Bollen, Riden and Cox, 2007; Riden and Bollen, 2007).

An essential innovative tool to promote traceability is an IT (Information Technology) system which may be used to provide a smooth information flow for a business (Bevilacqua, Ciarapica and Giacchetta, 2009). Ruiz-Garcia, Steinberger and Rothmund, (2010) suggest software architecture with standards to offer a tool for controlling traceability and to provide managers with pertinent information.

Recently, analytical methods have been developed for a more efficient traceability. Electrochemical biosensors for food pathogen detection (Palchetti and Mascini, 2008) chromatography to quantify minor components of food (Steinhart and Biernoth, 1997) and nanotechnology-based analytical methods sensing exogenous and endogenous compounds in food (Valdés, et al., 2009) are examples of efforts to increase the security and quality of food production.

The debate of local versus global food retailing has been one focus of discussion within European communities, and is also examined in research. Basically, this debate reflects how people are unsatisfied with the global distribution system (Stagl, 2002) and how a sizable part of consumers and producers think that local food production can be a more sustainable and safer way to feed a population, than the global agro-industrial food production system. However re-established local food markets do not automatically work the way that producers and consumers want (O'Hara and Stagl, 2001). Reliance on local experts, social interaction, and spatial feedback functions need to be developed in local food markets to be competitive. Regionally grown food can supply regional institutions (e.g., schools). With the active support and innovative suggestions of regional institutions, the local community can benefit from fresh and nutritious food and, at the same time, support sustainable farming in the region (Vogt and Kaiser, 2008). Nevertheless the globalised market has some important advantages: favourable costs, access to international market, and reliable sources of supply (Russell and Taylor, 2014).

## 2. Research methodology

The scope of our research is to examine the network of the local fruit and vegetable market, and to understand its logistical functioning with respect to traceability and assurance of a safer food supply for the local population. The aim of the applied methodology is to improve the local retail system through innovations to maintain a competitive business.

Lehota, et al. (2009) analysed the main marketing channels for the Hungarian fresh vegetables-fruits sector and distinguished three specific types:

- Grower - "Wholesaler market" - Small – scale vegetable and fruit retailers,
- Grower - Private wholesaler - Large – scale private retail chains, and
- Grower - Producer cooperatives - Large – scale retail chains.

Our research is concentrated on the first marketing channel type: grower-wholesaler-small scale vegetable and fruit retailers. The supply chain members were investigated vertically on four levels. The first level is the producer, the second level is the wholesaler, the third level is the small-scale retailer and the fourth level is the consumer.

Data collection was performed at the end of 2013, and lasted for one month. Four producers were interviewed at their farms using a structured oral method. Questionnaires were developed to collect information from wholesalers, small-scale retailers and consumers. The town, numbering 206 thousand inhabitants, has two markets where fruit and vegetable retailing activities take place. There is a market for wholesalers on the outskirts of the town, where the data were collected from the wholesalers. The town has a fruit and vegetable market in the centre, where the small-scale retailers and consumers were questioned. In our research 29 wholesalers, 44 small-scale retailers and 241 consumers were included in the sample.

The questionnaire data were analysed using SPSS 15.0 software. Basic statistical analysis, regression analysis and ordinal regression procedure were performed. The SPSS Ordinal Regression procedure, or PLUM (Polytomous Universal Model), is an extension of the general linear model to ordinal categorical data. The link function is the function of the probabilities that results in a linear model in the parameters and which defines what goes on the left side of the equation. This function serves as the link between the left side of the equation and the right side (Norušis, 2008). In our research, the link function is the logit function, which is the log of odds (quotient of the cumulative probabilities for the  $j$ -th category which is the importance level of traceability).

Hence, the model that was used in the analysis is as follows:

$$\ln\left(\frac{\text{prob}(\text{score of } Y \leq j)}{\text{prob}(j < \text{score of } Y)}\right) = \alpha_j - \beta_1 X_1 + \dots + \beta_k X_k \quad (1)$$

Where:  $\beta_k$  parameter of the  $k$ . variable,  $\alpha_j$  threshold variable of the  $j$ - the category,  $j$  goes from 1 to the number of the categories of  $Y$  minus 1,  $Y$  dependent variable is the importance of traceability categorized from 1 (the less important) to 5 (the most important), and  $X_k$  independent variables were the several questions in our questionnaires. The threshold values are not of much interest. Their values do not depend on the values of the independent variable; they function as the intercept in a linear regression (Norušis, 2008).

Positive parameter values mean that when the value of the independent variable increases, the likelihood of larger value of the dependent variable increases. Negative parameter means the opposite: the likelihood of decreasing values of dependent variable increases. Three different models were set up according to the opinions of customers, small retailers and wholesalers. Some questions were left out of the models, because they ruin the goodness of the model fit. Questions were measured on a 1-5 scale except the number of the official controls and supply chain members and time spent in fruit and vegetable business.

Five hypotheses were formed. Our hypotheses are:

- There are deficiencies in data collection at fruit and vegetable producers.
- The data erosion in the fruit and vegetable chain is significant.
- The willingness to know the supply chain members is changing downstream the supply chain.
  - The final customer intends to pay more for the product providing more detailed information.
  - Increased control of the fruit and vegetable chain improves the traceability.

### **3. Results and discussion**

The consumer of vegetable and fruit products of a local market has all the information from the retailer however the quality of information depends on each supply chain member. Therefore the approach of the research is complex studying all the effects of the system starting with the expectations of the consumer through the retailers to the producers to find possible innovations in the system to make the retailing more competitive.

#### ***Consumers***

The interview questions for final consumers were divided into four groups, as follows:

- Production
  - Importance of the location of production
  - Importance of the chemical treatments and production technologies applied in production
  - Environment conscious production
- Distribution
  - Importance of knowing the members of the supply chain of vegetables and fruits
  - Importance of knowing the applied chemicals during storage and transport
  - Importance of knowing the technology of storage and transport
- Product characteristics
  - Importance of the date of harvest
  - Willingness to pay more for domestically produced vegetables and fruits
  - Importance of domestically sublimated vegetables and fruits
  - Willingness to consume GM (Genetically Modified) plants

- Control
  - Intensity of official control of vegetables and fruits
  - Satisfaction with the information received from the seller
  - Strictness of official control on fruits and vegetables
  - Willingness to pay more for being better informed about fruits and vegetables.

The location (e.g.: farm and geographical area) of the product and chemical application of plants were the most important factors for customers (4.5-4.7), (table no. 1). Environmentally sound production was rated lower, but it was also a prominent expectation of customers. Transport, storage and the date of harvest were significantly less important considerations than the factors mentioned above. Although people did not really possess proper knowledge about genetically modified crops, some consumers asked the interviewer to explain what the term GM food meant and genetically modified products received - very low score (1.4) among the factors.

Consumers perceived only 1.2 official control events at the fruit and vegetable market. Indeed, these respondents gave one average scores for the efficiency of the control of products (3.0) and they demanded an improvement of the standards for product supervision (3.8). Consumers were not content with the information that they received from the sellers (3.6); however, they did not intend to pay more to receive additional information either. Consumers' high expectations regarding information availability on a product's lifecycle, seen together with the fact that they do not want to pay more to be better informed, suggests that consumers would buy more products from sellers who give them more precise information.

**Table no. 1: Descriptive statistics of the given questions in the customers' questionnaire (n = 241)**

Questions	Mean	Std. Deviation
Information about the number of supply chain members	4.2	1.3
Location of production	4.5	1.1
Chemical treatments and production details	4.7	0.8
Information about the harvesting date	3.6	1.5
Information from the small-scale retailer	3.6	1.1
Information about the transport and storage	4.0	1.3
*Number of perceived official controls	1.2	2.0
Environment conscious production	4.3	1.1
Willingness to pay more for domestic products	1.1	0.3
Willingness to pay more for better information	3.0	1.5
Importance of the domestic origin	4.3	1.1
Genetically modified products	1.4	0.9
Efficiency of control	3.0	1.4
Demand to increase the standard of the supervision	3.8	1.5

*Note: Mean score based on: 1 very low, 5 very high, except the marked (\*) row*

Analysing the factors with the Mann-Whitney non-parametric test, significant differences were found between genders. It can be generally stated that women (55.2%) are more sensitive about the traceability and quality of their fruits and vegetables than men (44.8%). The origin of the product, the conditions of transport and storage, the date of harvest and the domestic origin of the products were more important for women than men. GM products were rated lower by women than men.

Evaluating the answers by different age groups (by Kruskal-Wallis test), we found that people older than 65 years, 20% of the sample, consider it more important to deal with the factors of traceability and quality. These respondents called for stricter controls, and they were less willing to consume GM plants. Only the question about the importance of domestic origin was judged differently by different income groups of consumers. People from the highest gross income categories (over 650 EUR/month) did not consider domestic products better than foreign fruits and vegetables, while low-income consumers (below 330 EUR/month) preferred domestic products.

Based on the estimates of the parameters above, it can be stated that if the chemical treatment of plants and production details are important for the consumer, the probability that they are interested in the number of supply chain members is higher by 75% (table no. 2). The exponential function of the coefficients is the odds for higher to lower scores on the rankings of the consumers taking traceability into consideration. This also means that negative coefficients are associated with poorer scores on ranking the importance of traceability.

**Table no. 2: PLUM model estimates, consumers**

<b>Factors (independent variables)</b>	<b>Estimates (<math>\beta</math>)</b>	<b>Odds (Exp(<math>\beta</math>))</b>	<b>p value</b>
Location of production	0.274	1.315	0.068
Chemical treatments and production details	0.562	1.754	0.010
Information about the harvesting date	0.261	1.298	0.025
Information from the small-scale retailer	0.269	1.309	0.069
Information about the transport and storage	0.615	1.850	0.000
Efficiency of control	-0.003	0.997	0.983
Environment conscious production	-0.253	0.776	0.179
Willingness to pay more for domestic products	0.954	2.596	0.096
Willingness to pay more for better information	-0.234	0.791	0.048
Gender	-0.501	0.606	0.137
Age	0.504	1.655	0.005
Qualification	0.089	1.093	0.646
Gross income per family member	-0.435	0.647	0.010

*Note: Goodness of model fit ( $p=0,000$ ); Nagelkerke pseudo R-Square (0,315); Link function: Logit, Dependent (Y) variable is traceability (information about the number of supply chain members)*

Odds show us the influential power of the dependent variables on traceability. When the odds are less than one, the probability that the traceability is of greater importance for the consumer is less than the probability that the traceability is of less importance. Moreover, when the



odds are greater than one, the interpretation is exactly the opposite. The most important factors people want to know about a product's lifecycle are as follows: chemical treatments, the means of transport and storage and the date of harvest. The likelihood that an older person thinks that traceability is important is 65% higher than in the case of a younger person (below 30 years). People from the highest income category are less interested in the traceability of a product (with 1.55 odds, the probability is 55% higher). If the consumer is content to pay more for better information, the likelihood that he is interested in traceability is smaller (with 1.26 odds, the probability is 26% higher). Probably the reason for this result is that the possession of more information increases trust in a product. Traceability attributes cannot be differentiated by gender or qualification. A connection between the knowledge of chain members and information about the production details from the seller was not perceived, which may suggest that the consumer thinks that the truthfulness of the seller may be questionable.

### ***Small-scale retailers***

The majority of small-scale retailer businesses is registered in the town (70%) and 59% of businesses worked as sole proprietors.

Small-scale retailers were asked about the upstream, downstream information flow and about their opinion about the control of the supply chain:

- Upstream
  - Products bought directly from the producer
  - Known data of producers
  - Known harvest dates
  - Known production circumstances
  - Known number of SC members
  - Information about the technology of storage and transportation
  - Importance of the domestic origins
- Downstream
  - Written information to the final customer about the history of the product
  - Orally given information to the final customer
  - Satisfaction of customers with the information given with the product
- Control
  - Lengths of time in the business
  - Number of official inspections
  - Degree of contribution to healthy product supply by current practice of production and trade
  - Adequacy of official control to fruit and vegetable SCs.

The majority of small-scale retailers (56%) are producers as well. The majority of them are familiar with harvest dates (3.9), producer data are mostly available to small-scale retailers (3.1). They have current information about the technical details of a product’s production (3.8) as well as the information about the number of supply chain members (4.0), and mainly local products are sold (4.3) (table no. 3).

Small-scale retailers were inspected 7 times per year. On a 1-5 scale, they are rather satisfied with the healthiness of the local fruit and vegetable supply (3.7) and with the efficiency of control (4.1) (table no. 3).

**Table no. 3: Descriptive statistics of the given questions in the small-scale retailers’ questionnaire (n = 44 out of 65)**

Questions	Mean	Std. Deviation
Purchases directly from the producer	3.0	1.0
*Time spent in fruit and vegetable business (years)	12.8	10.2
Information about the data of the producer	3.1	1.2
Information about the production details	3.8	1.5
Information about the number of supply chain members	4.0	1.4
Information about the harvesting date	3.9	1.5
Importance of the domestic origin	4.3	1.2
*Number of perceived official controls	7.3	7.9
Efficiency of control	4.1	1.1
Satisfying information for the consumers	4.2	0.9
Healthy food for the population	3.7	1.3

*Note: Mean score based on: 1 very low, 5 very high, except the marked (\*) rows*

The quality of information that the consumer receives from the small-scale retailers affects traceability the most (table no. 4). If the consumer is satisfied with the information from the small-scale retailer, the traceability functions well, since the chance that the small-scale retailer knows the life cycle of their product is high. The stronger the official control on the small-scale retailers (the number of checks), the more informed the small-scale retailer is about traceability. Stronger monitoring activities increased the probability of awareness about the traceability of products by 37%. However, as the small-scale retailers were more satisfied with the way the official control was done, they considered the origin of a product to be less important for them. As was the case with wholesale retailers, there were found factors that negatively affected the traceability of fruit and vegetable chains. Small-scale retailers who spent longer time in the trade are less interested in the traceability of products than those who started their businesses more recently.

**Table no. 4: PLUM model estimates, small-scale retailers**

<b>Factors (independent variables)</b>	<b>Estimates (<math>\beta</math>)</b>	<b>Odds (<math>\text{Exp}(\beta)</math>)</b>	<b>p value</b>
Information about the production details	2.910	18.357	0.001
Time spent in fruit and vegetable business	-0.174	0.840	0.006
Number of perceived official controls	0.313	1.368	0.008
Healthy food for the population	-0.319	0.727	0.467
Efficiency of control	-1.206	0.299	0.018
Purchases directly from producers	0.098	1.103	0.000

*Note: Goodness of model fit ( $p=0,000$ ); Nagelkerke pseudo R-Square (0,747); Link function: Logit Dependent (Y) variable is traceability (information about the number of supply chain members)*

**Wholesalers**

59% of the wholesalers operated in a company or partnership, 41% were sole proprietors, 41% were registered in the city and 59% were registered in the surrounding settlements. A significant portion (47%) of the wholesalers is producers.

Similar to the small-scale retailers, wholesalers were asked about the upstream, downstream information flow, and about the control of the supply chain:

- Upstream
  - Products purchased directly from the producer
  - Known data of harvests of the products
  - Known technology of production
  - Information about the upstream SC members
  - Information about the storage and transportation practices of upstream SC members
  - Known number of upstream SC members
  - Importance of the domestic origin
- Downstream
  - Number of downstream SC members
  - Written information given to the next downstream member
  - Oral information given to the next downstream member
- Control
  - Length of time in business
  - Number of official control
  - The consequences of official control
  - Contribution of current production and SC practices to the healthy supply of fruit and vegetables
    - Adequacy of current official control over the fruit and vegetable market.

Mainly, products are purchased directly from the producer (3.8) (table no. 5). In the majority of cases, the wholesaler is familiar with the main data of the producer (4.4), even the date of harvest and the details of the production technology are known relatively well 3.7 and 3.6, respectively. When the wholesalers were asked how many retailers had owned the product between them and the producer, the answer was that they knew the exact number (2.9). A similar number of retailers (3.0) were between the wholesalers and the consumer. The number of retailers is rather high since the unprocessed vegetables and fruits are owned by 5-6 businesses before they are bought by the consumer. This means that not just the economic efficiency is questionable in the process, but the control of product traceability, quality and safety is also problematic in the chain. The wholesalers were inspected by government officials once in every 2-3 years and resulted in fines in 5.8% of the cases. Wholesalers answered on a 1-5 scale that they were slightly satisfied with the supply of healthy fruits and vegetables (3.7), and they found that the institutional control was not satisfactory (3.7).

**Table no. 5: Descriptive statistics of the given questions in the whole-scale retailers' questionnaire (n = 29)**

<b>Questions</b>	<b>Mean</b>	<b>Std. Deviation</b>
Information about the production details	4.0	1.0
Purchases directly from the producer	3.8	1.3
Information about the data of the producer	4.4	1.1
Information about the number of supply chain members	3.4	1.3
Information about the storage and transport	4.0	1.1
Information about the harvesting date	3.7	1.2
Importance of the domestic origin	3.9	0.9
*Number of perceived official controls	14.6	13.7
Efficiency of control	3.7	0.9
Information about the production in supply chain	3.6	0.9
Information about the number of supply chain members between the wholesaler and the consumer	2.9	1.3
Information about the number of supply chain members between the wholesaler and the producer	3.0	4.1
*Time spent in fruit and vegetable business (years)	13.1	5.4
Healthy food for the population	3.7	0.8

*Note: Mean score based on: 1 very low, 5 very high, except the marked (\*) rows*

According to the wholesalers' opinion, traceability mainly depends on the activities of producers and retailers, i.e. how they can supply the population with healthy, safe and good quality fruits and vegetables (table no. 6). Those wholesalers whose opinion is that the supply of the population is rather satisfactory know the members of the supply chain; they thoroughly follow the product throughout the process. Those wholesalers whose opinion is that the existing practice cannot serve the population with healthy products probably do not have information about the flow of products in the system. Another important factor, as it is in the case of consumers, is the knowledge of storage and transport activities. If the information about the circumstances of storage and transport are important for the wholesaler, the chance that traceability is treated as a significant factor is doubled and these retailers know the partners in the chain better.

**Table no. 6: PLUM model estimates, wholesalers**

<b>Factors (independent variables)</b>	<b>Estimates (<math>\beta</math>)</b>	<b>Odds (Exp(<math>\beta</math>))</b>	<b>p value</b>
Purchases directly from the producer	0.065	1.067	0.131
Information about the data of the producer	0.116	1.123	0.214
Information about the harvesting date	0.225	1.258	0.079
Information about the production details	0.267	1.305	0.050
Information about the storage and transport	0.690	1.994	0.031
Information about the production in supply chain	-6.002	0.002	0.142
Time spent in fruits and vegetables business	-0.513	0.598	0.038
Number of perceived official controls	0.563	1.755	0.033
Healthy food for the population	9.233	1024.390	0.042
Efficiency of control	11.692	119670.061	0.067

*Note: Goodness of model fit ( $p=0,000$ ); Nagelkerke pseudo R-Square (0,898); Link function: Logit Dependent (Y) variable is the importance of traceability (the importance of information about the number of supply chain members)*

If a wholesaler had an above average number of official controls, the chance of his being more knowledgeable about the supply chain members multiplied by 1.75, over those who had a smaller number of controls. This relationship is also true for the small-scale retailers. There are factors that negatively affect a positive attitude towards traceability. For example, the longer a wholesaler is in the fruit and vegetable business, the less important it becomes for that person to have information about traceability. This tendency is similar in small-scale producers. Similar to the consumers, wholesalers who are interested in technical details of the production of their fruits and vegetables are more determined to increase the traceability of the products, the chance of which is 1.3 (table no. 6).

### **Producers**

Three vegetable producers and one fruit producer of the region were interviewed. All of them are members of the local food chain. Each vegetable farmer cultivates less than one hectare of land, producing green pepper, cabbage, tomato, radish, and kohlrabi. The fruit producer has four types of fruit (apple 40 ha, pear 9 ha, plum 4 ha, and cherry 3 ha). Vegetable producers have three regular employees, while 11 people work for the fruit farm. The interviewed business owners have been working in fruit and vegetable production from 5 to 36 years.

Smaller producers documented only those facts concerning production that they had to give to the buyer when a vegetable was sold. This document contains the chemical protection data: the date of treatment, the name of the chemical, the rate of application and the decomposition time of the agent. The fruit producer joined the Agricultural Environment Protection Program; therefore, he is required to keep records, in accordance with EU requirements, to comply with the rules of the programme. Therefore, the data collection of the fruit farmer is more complex and precise than the recordkeeping of farmers who are not in the programme. Farmers should make notes on the technological parameters of their plant production activities. However, because of the administrative burden, mainly small farmers often fail to comply with the rules. Vegetable farmers spend 2-12 hours in a season maintaining records

about their production, but the fruit producer spends two person-months per season to register data.

The following SC member receives written information from the product about the chemical applications, the name of the producer, the registration number of the producer, the species and variety of the vegetable or fruit and the category of the quality. These documents do not appear on the package of the product; therefore, the following partners in the SC do not always receive them. Only the fruit producer’s product packaging labels indicate the main data of the farm. Nevertheless, the farmers answered that they did not know how many retailers were between them and the final consumer and that they did not have any information about the transportation methods or storage conditions down the SC. They were satisfied with the food security of the system. Farmers are supervised by the government; smaller farmers were visited once a year and the largest producer was checked three times per year.

***Vertical relationships in retailing***

Performing Kruskal-Wallis nonparametric tests, there were differences through the process. There were increasing or decreasing tendencies for three factors: information about the number of chain members, importance of domestic products and number of perceived official controls (table no. 7). Consumers were most interested in the lengths of the chain the products went through. For small-scale retailers, the number of members of the supply chain was less important and the wholesalers’ score was the lowest. Based on the qualitative data collection from the producers, it can be stated that the farmers cared less about the number of members from them to the consumer, since each agricultural producer said that he did not know how many businesses were involved in the process.

**Table no. 7: Evaluation of similar factors by the chain members**

Factors	Consumer n = 241	Small-scale retailer n = 44	Wholesaler n = 29	p value
	Averages			
Information about the production details (1-5 scale)	4.320	3.773	3.962	0.040
Information about the number of supply chain members (1-5 scale)	4.224	4.000	3.440	0.000
Importance of the domestic origin (1-5 scale)	4.320	4.250	3.917	0.012
Number of perceived official controls	1.178	7.341	14.630	0.000
Efficiency of control (1-5 scale)	3.038	4.045	3.731	0.000
Satisfying information from the seller (1-5 scale)	3.622	4.227	3.600	0.003

Buying domestically produced fruits and vegetables showed a similar trend from the wholesaler to the consumer, where customers’ score was the highest and the wholesalers’ the lowest. This result reflects the recent tendencies in the fruit and vegetable trade. Cheaper foreign fruits and vegetables displace domestic products, mainly in the winter time, and the interest of vendors is to trade foreign products in order to be more competitive with lower

prices. However, despite the regular domestic food scandals, the opinion of the citizens is that the importance of the domestic origin of fruits and vegetables is higher than importance of products from abroad.

Consumers had noticed only one official control at the fruit and vegetable market; however, small-scale retailers were checked 7.3 times, and wholesalers 14.6 times. Despite the lack of regularly experiencing checks, consumers formed a rather definite opinion about the official supervision, since their score is lower than the score of small-scale retailers and wholesalers. Vendors were relatively satisfied with the supervision, because the cases of penalties were seldom and official controls were not done frequently.

Having information about the details of the production was most important for the consumers, however, customers of wholesalers were less satisfied with the information they received from the previous supply chain members.

### **Conclusions**

As a result of our research on local vegetable and food retailing innovative solutions in retailing processes are suggested to improve the competitiveness of the area mainly the ways how to promote sales by better traceability data.

Farms with bigger areas and more employees have the expertise and the means to register the most significant events of their production throughout the logistic system of the enterprise. Some EU programmes put pressure on agricultural businesses, as the payments are tied to proper registration of production. However, the number of small producers performing record keeping is rather limited: these producers only produce the document that is required when the product is sold. The basis of traceability starts at the producer level; therefore, the most integral set of data should be determined which should be recorded by each producer to be more competitive on the local market.

When the product is sold from the farm, notes of chemical applications (“log of sprayings”), and the genus name of the fruits and vegetables, and the data of the producer are given to the retailer. Since the trace of the product is not known by the producer and a product will pass through 3-5 vendors in many cases, the chance that the information gets to the customer is often low. The erosion of information can be eliminated with innovative IT solutions in the future; however, the level of information technology and the knowledge of the chain members should be adjusted to the task.

The importance to be familiar with the number of supply chain members is scored more significantly by the customer and was decreasingly important throughout the chain and the least important for farmers. This factor functioned as a reverse bullwhip effect, where the importance of traceability decreases from the customer to the producer. As scientifically established research has not been performed on this field in this locality, retailers and producers do not have valid information about the process. Thus, the regular transfer of information may help them to better serve the final customer.

In cases of sales to the customer, products are labelled with genus name and the classification (class I, class II, and class III); no other written information is given in practice. Customers are not satisfied with the information about the fruits and vegetables they receive from the seller, but they are very interested in the records on each product. Yet, customers do not

intend to pay more for better information; however, they prefer products with more precise information. By knowing this, retailers and producers can increase their sales by providing more information to the customer about the life cycle of the product.

Increased control on the fruit and vegetable chain made the participants (SC members) more interested in traceability, which means that there are potentials in increased supervision that are also promoted by the customer. Nonetheless, presumably the main reason behind the deficiencies in the traceability of fruits and vegetables is that the actors in the business try to avoid tax payments on the product sold; a problem which was not the subject of this publication, but which should be taken into account to examine the field in complexity.

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