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Challenges for the Development of Safe Vegetables in Vietnam: An Insight into the Supply Chains in Hanoi City

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The development of vegetable sector plays an important role in improving living standards of farmers as well as more contribution to the export of Vietnam agriculture industry. However, the unsafety of vegetables has still received much concern from public and Vietnamese government. The achievement of the program “safe vegetable” (indicating vegetables certified as safely under the state regulations) has been very limited in spite of great efforts from the government over the past 20 years since 1998. This issue motivates us to examine the challenges of safe vegetable sector based on a comprehensive approach from the supply chains. In addition to literature review, a rich volume of our primary data was collected from in-depth interviews of all stakeholders (farmers, managers of cooperatives, local collectors, distributors, and local government) in supply chains of safe vegetables and performed semi-structured questionnaires toward consumers in Hanoi city in March 2018 and March 2019. Our findings indicated a considerable increase in market share of safe vegetables distributed through modern retailing system compared to that in previous studies, which were carried out around ten years ago. However, 80% of safe vegetables were still distributed to traditional markets at no premium price compared to conventional/uncertified counterparts. One main reason came from low level of consumer trust. Besides, weak relationship among stakeholders in safe vegetable supply chains by the lack of mutual trust, transparent information providing and interest sharing was also a big obstacle. Another reason was that the state management in vegetable safety focused much on safe vegetable production areas, whereas lack of food safety control in distribution and business process can hamper the development of safe vegetable market share. Finally we proposed main policy recommendations for developing the safe vegetable segmentation in Vietnam.

Key words: Food safety, safe vegetables, supply chain, vegetables, Vietnam

INTRODUCTION

Food safety and food poisoning issues have been paid major attention from public in Vietnam, especially related to vegetables (Ha *et al.*, 2019; Nguyen-Viet, *et al.*, 2017; Van Hoi *et al.*, 2009; Wertheim-Heck *et al.*, 2014). Specifically, the consumers in Vietnam are much worried about unsafe vegetables due to high chemical residues of pesticides or growth stimulator/regulators (Ha *et al.*, 2019; Nguyet-Viet *et al.*, 2017). The unsafety of vegetables not only caused negative impacts on domestic market development but also hampered the expansion of export markets. In fact, export of vegetables was very modest in quantities and values, and its growth tended to diminish when they cannot meet the requirements about food safety at developed countries such as the U.S, Japan (Chu Khoi, 2018). However, data about vegetables are often not updated and not separated from fruit sector, which can cause difficulties in

identifying specific problems and then proposing suitable solutions for boosting vegetable development in Vietnam.

In order to improve the safety of vegetables and prevent food poisoning cases by the overuses of pesticides, the program “safe vegetables” was introduced in 1998 by Vietnam Ministry of Agriculture and Rural Development (MARD). The main content of this program was to plan area for safe vegetables and control the safety of safe vegetables in such land based on specific regulations about minimum residual levels of chemical pesticides, fertilizers, heavy metals and nitrate, which is not harmful to human health (MARD, 1998; MARD, 2012). At present, there are three types of safe vegetables based on production standards: hygiene safety, GAPs (i.e. VietGAP, Global GAP), and organic standards (Vu *et al.*, 2016). The safe vegetable program has three main solutions including: (i) identifying and certifying planned area for safe vegetables; (ii) holding technical training to farmers for producing safe vegetables; (iii) encouraging and building modern retailing systems (supermarkets and safe food shops) for distributing safe vegetables. In addition, incorporating other higher standards for safe vegetables (i.e. Global GAP, ASEAN GAP) the government also introduced and released local GAP standard, namely VietGAP for safe vegetables, fruits since 2008 (MARD, 2008). Then the government set specific target of 100% of total safe vegetables/fruits under VietGAP by

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2015 (Prime Minister, 2008). However, its achievement of the program is very modest as area for safe vegetables (including hygiene safety and VietGAP certification) was only around 8 – 8.5% in 2015 (Tung, 2016). Main reasons can be due to low trust in safe vegetables by Vietnamese consumers (Van Hoi *et al.*, 2009; VECO Vietnam, 2016; Wertheim–Heck *et al.*, 2014) or weak capability for food safety control by the government (Nguyet–Viet *et al.*, 2017; Van Hoi *et al.*, 2009).

Recently, Vietnamese government has concentrated more on the approach to supply chains in controlling food safety and developing safe food sector, which was officially initiated from the Decision 80 of the Prime Minister in 2002 (Prime Minister, 2002). Particularly, expanding numbers of food supply chains, encouraging the links among farmers, cooperatives, distributors, processors and retailers, and monitoring food safety based on chains are often mentioned as a crucial pathway. Consequently, topics about food safety management based on supply chains have been more frequently covered on public media (Anh Phuong, 2019; Hai Nam, 2018). This approach is also related to building food traceability system, which has been extensively applied by developed countries. Researches on such system were also carried out by many scholars at these countries (Badia–Melis *et al.*, 2015; Wognum *et al.*, 2011). By contrast, food traceability system in Vietnam is just at an early stage. Although regulations on food traceability was officially enacted since 2011 (MARD, 2011), the results were very limited. At present, some big cities like Hanoi and Ho Chi Minh have been taking some efforts to apply this traceability system based on adopting new technology using QR code, bar code that can help consumers use electronic devices to check the origin of safe foods.

To achieve both main tasks as controlling food safety more efficiently and boosting the development of vegetable sector through supply chains in Vietnam now, it is important to understand problems facing all stakeholders in the chains. Several studies on supply chains/value chains of foods (mainly vegetables and fruits) were carried out in 2005, 2006 under the GTZ SME program (GTZ SME, 2019). However, few researches on safe vegetables (only two for Ho Chi Minh and Hanoi cities) were also out of date as they were carried out over ten years ago. A rapid expansion of modern food retailing system has led to considerable changes in numbers, proportion of vegetable quantity and roles of actors in the supply chains. Especially, previous studies failed to clearly estimate the proportion of safe vegetables distributed modern retailing system (supermarkets, safe food shops) and traditional markets (wet/open markets, street vendors). The market segmentation of safe vegetables in modern retailing outlets is very important because the price premium and brand familiarity of safe vegetables (compared to conventional/uncertified ones) only exist such markets. In addition, such work was limited in assessing specific problems that hamper the development of safe vegetable supply chains, except for the work of Van Hoi *et al.* (2009), which were carried out 10 years ago.

Based on our understanding, it is crucial to re-examine problems facing a supply chain's stakeholders based on updated information about the development of safe vegetables. Therefore, in this study, we aimed at two main objectives: (i) providing updated and more comprehensive information about vegetable development as well as its role to Vietnam economy; (ii) analyzing current supply chains of safe vegetables combined with identifying urgent problems facing all actors in these distribution channels.

Our main results were structured as follows. Firstly, we introduced the current development of vegetables focusing on vegetable area, production quantity and yield, export quantity and values. Next, major problems related to food safety of vegetables and the introduction of safe vegetable program were presented. Third part of the result was to analyze the supply chain of safe vegetables in Hanoi city, and identifying specific problems facing stakeholders in the supply chains based on a typical case study of safe vegetable channel in Van Duc commune, Gia Lam district, Hanoi city.

DATA AND METHODS

First, we systematized necessary data based on previous studies, reports and database from Ministry of Agriculture and Rural Development, General Statistics Office of Vietnam, Hanoi government, FAO statistics about the development of vegetables in general, safe vegetables in particular.

Second, our primary data was collected from two surveys in Hanoi city in 2018, 2019. We chose Hanoi city for our research based on some main reasons: (1) serious problems about food safety facing crowded population (7.6 million people in 2017, by Hanoi Municipal People's Committee, 2018); (2) big area for safe vegetable production; (3) several solutions for developing safe vegetables by local government.

To get these data, we used in-depth interview of local government to get main information about policies for safe vegetable production and to identify problems in controlling food safety as well as supporting safe vegetable development. Next, to map the supply chain of safe vegetables, we began to interview the managers of safe vegetable cooperatives. Based on such information, distributors/local collectors were investigated. Finally, five farmers of each cooperative were randomly selected for in-depth interview. Moreover, we applied semi-structured questionnaires to collect necessary information about consumers' trust, behavior to purchase safe vegetables, which addressed reasons preventing them to trust/distrust and not purchase safe vegetables. The detail information of the target surveyed was described in Table 1.

In this study, we mainly used descriptive and comparative statistics to provide the development of vegetables in general, the expansion of safe vegetables in particular. To map supply chain of safe vegetables in Hanoi city, we calculated the proportion of safe vegetables distributed at each actor, which were self-reported by

Table 1. Target survey and major information collected

	Target survey	Mode of data collection	Number of samples	Purpose	Survey Time
1	Local government	In-depth interview	2	To update information about development trend of safe vegetables, plan and policies for developing safe vegetables	March 2018 March 2019
2	Managers of cooperatives or farmer groups	In-depth interview	5	To get information about supply chain and problems/difficulties related to distributing safe vegetables	March 2018 March 2019
3	Distributors/ Local collectors	In-depth interview	5	To get information about supply chain and problems/difficulties related to distributing safe vegetables	March 2019
4	Farmers	In-depth interview	20	To understand problems related to safe vegetables production and selling, and to update supply chain	March 2019
5	Consumers	In-depth interview, Structured questionnaire	12 (in-depth interview) 403 (1 st survey), 250 (2 nd survey)	To explore consumer trust in safe vegetables; To identify factors affecting consumer behavior to purchase To evaluate consumer loyalty	March–April 2018, February 2019

interviewing targets described above. In addition, we also used direct quotation from data recorded during in-depth interview, which assisted in addressing specific problems facing supply chain actors.

RESULTS AND DISCUSSION

Overview of vegetable sector in Vietnam

Vegetable sector plays an increasingly important role in the whole agriculture industry in Vietnam. Total harvested area of vegetables was about 0.84 million ha in 2017, only behind paddy rice (7.7 million ha) and maize (1.1 million ha) based on statistics of Food and Agriculture of Organization of the United Nations (FAOSTAT, 2019). Fig. 1 shows that the vegetable harvested area has tremendously increased since 2011, two-fold number compared to annual average of the previous period. This area reached a peak of 0.89 million ha in 2014, then slightly decreased in three following years. Meanwhile, a stable increase in the vegetable yield appeared during 20 years, ranging from 12 tonnes/ha to around 17 tonnes/ha (in Fig. 1), which was much higher compared to the yields of rice (5.6 tonnes/ha), or maize (4.5 tonnes/ha) (GSO, 2018).

The growth in vegetable area and production has considerably improved people income. Especially, this industry is currently paid much attention from the government for export markets, yet the vegetable export quantity and value are still small. Total export quantity of vegetables was around 180 thousand tonnes in 2016, accounting for only 1.4 % of total quantity vegetable production. Although the export value of vegetables was modest, about 200 million USD in 2016, its increase achieved over six times higher compared to that of 1998,

which was shown in Fig. 2. The major export markets for vegetables (data combined with fruits) were China, at 70%, followed by Korea (3.6%), America (3.4%) and Japan (3.1%) in 2016. However, the recent growth of export market for vegetables and fruits has been diminishing because of high dependence of China market, which could lead to the failure of target of 10 billion USD in 2025 according to the plan of Vietnam Ministry of Agriculture and Rural Development (Chu Khoi, 2018). Issues about hygiene safety of vegetables was considered as big problems for domestic consumption and also for export, which we introduced in the following part.

Problems related to vegetable safety in Vietnam and the introduction of “safe vegetables” program

To cope with the unsafety of vegetables, the government released the program, namely “safe vegetables” since 1998. Initially, this program only requires minimum criteria to ensure the safety of vegetables produced under the hygiene and safety regulations of the World Health Organization in the Decision 67 of MARD (MARD, 1998). Then, integrated with high requirements of food safety from GAPs, safe vegetable production under VietGAP was born since 2008 under the Decision 107 of Prime Minister (Prime Minister, 2008). In addition, organic vegetables was also introduced from some small pilot projects in Hanoi, such as ADDA projects in 2007–2008. After that, the government has implemented three groups of solutions: setting planned area for safe vegetables (target 100% of total vegetable area in 2015), organizing training courses for safe vegetable production, and encouraging modern retail system (supermarkets, safe food shops), which was summarized in Fig. 3.

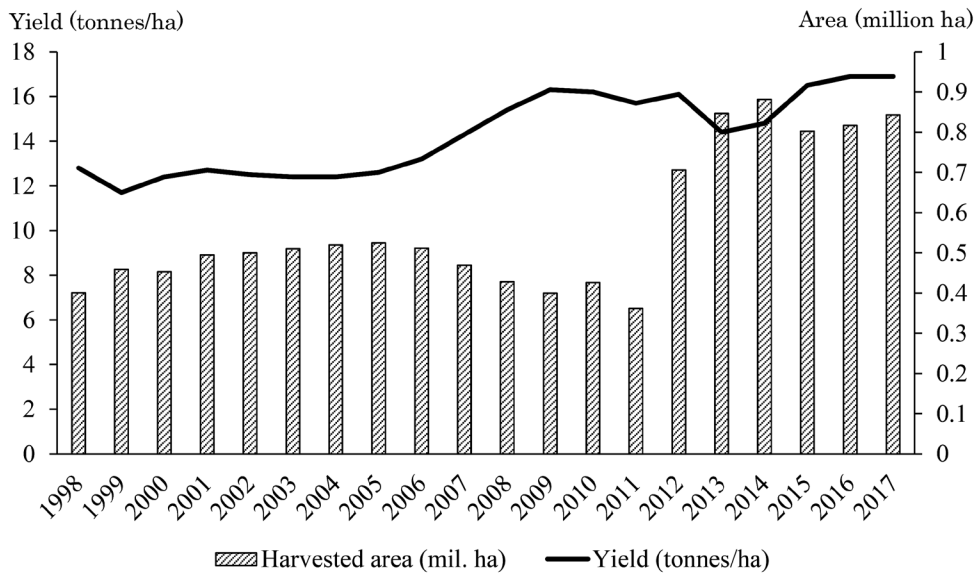


Fig. 1. Development of vegetable harvested area and yield during 1998 – 2017
 Source: FAOSTAT 2019. Note that area harvested implies total area used for vegetable planting in one year (it equals natural land multiplying with numbers of crops in one year).

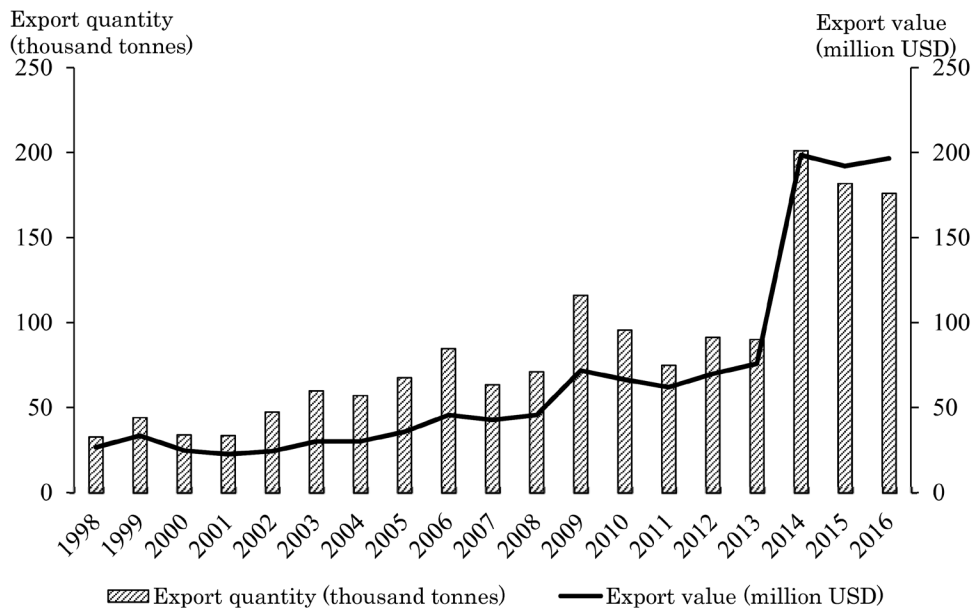


Fig. 2. Export quantity and value of vegetables during 1998 – 2016.
 Source: FAOSTAT 2019. Note: data about vegetables does not include maize, soybean and roots/tubers.

Over 20 years, the government has organized thousands training courses for safe vegetable production (i.e. Integrated Pest Management, GAPs), at all vegetable production areas. However, the area for safe vegetables is much lower as expected (according to the plan, all areas are certified as enough conditions for safe vegetables production in 2015), at around 8 percent of total 880 thousand vegetable land (Tung, 2016). In fact, there

is no comprehensive and official statistics about planned/certified area¹ for safe vegetables and especially actual areas for producing safe vegetables in Vietnam nationwide. Some provinces having largest planned area for safe vegetables are Hanoi city (5,100 ha, 42% of total vegetable land), Ho Chi Minh city (3,464 ha, 95%), Lam Dong province (2,500 ha, 20%). We mapped the reasons to introduce “safe vegetables” program and its main con-

¹ Planned areas indicates those certified as have enough conditions for producing safe vegetables (land soil, quality of water source, heavy metal in soil) under the regulation of Vietnam Ministry of Agriculture and Rural Development. We also note that planned areas are different actual land for producing safe vegetables. In addition, planned areas indicate natural area unit, not harvested/cultivated land.

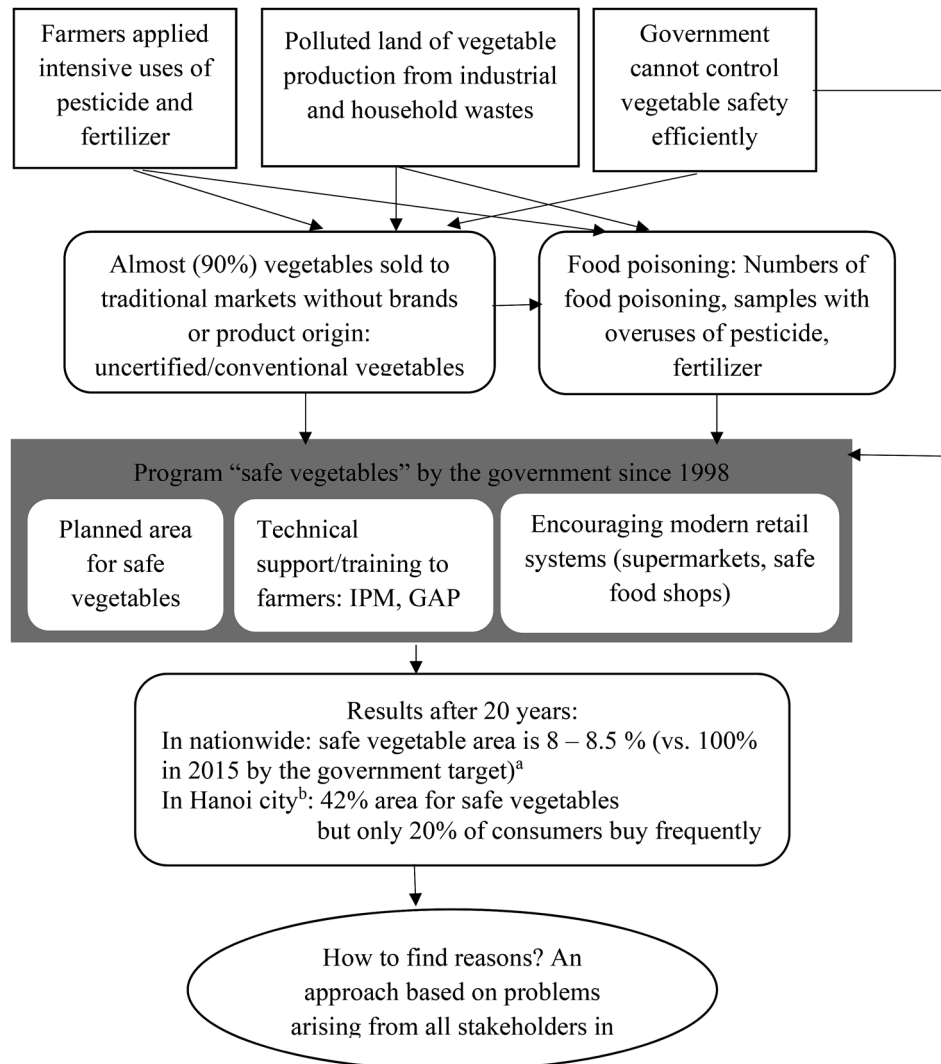


Fig. 3. Introduction of safe vegetable program, its limitation and our research approach.
Note: Data sources: ^a Tung (2016), ^b Our finding (2018, 2019)

tent in Fig. 3.

One big question raised here is why the achievement of safe vegetable program was very limited, whereas Vietnam consumers' demand for safe vegetables is high (Hai *et al.*, 2013; Thai *et al.*, 2017). Therefore, we tried to seek evidences for such reasons based on generalizing data from previous reports, and especially from our in-depth interviews of all stakeholders in the safe vegetable supply chain in Hanoi city in the next section.

An insight on arising problems in supply chain of safe vegetables: Case study in Hanoi city

Supply chain of safe vegetables in Hanoi city

Planned area for safe vegetables in Hanoi city stabilized around 2,000 ha during ten years (2001–2010), then expanded quickly since 2011 (see more detail in Fig. 4). By 2016, total planned area for safe vegetable production was around 5,100 ha, accounting for 42% of total vegetable land. It is estimated that total quantity of safe vegetables in Hanoi city was around 0.25 million tons per year, comprising 25% total demand of Hanoi cit-

izens. Meanwhile, quantity of conventional vegetables accounted for 0.35 million tons, meeting 35% the local people consumption amount. This indicates that Hanoi needs to import 40% of vegetables from surrounding areas such as Hai Duong, Vinh Phuc, Hung Yen, even from Lam Dong provinces, and Ho Chi Minh city.

Supply chain of safe vegetables in Hanoi was depicted in Fig. 5. Almost safe vegetables (70 – 85%) were distributed directly to traditional markets before handing to consumers. It is necessary to note that the prices of safe vegetables through this channel is not different with conventional ones, which may lead farmers to unexpected motivation for leaving safe vegetable production. Meanwhile, only 10 to 15% safe vegetables were delivered to consumers through modern retailers (supermarkets and safe food shops) with the higher prices compared to conventional vegetables. This proportion is higher compared to around 5% in the report of Hanoi Department of Plant Protection (2016), which indicates a considerable increase in quantity of safe vegetables distributed through modern retailing system.

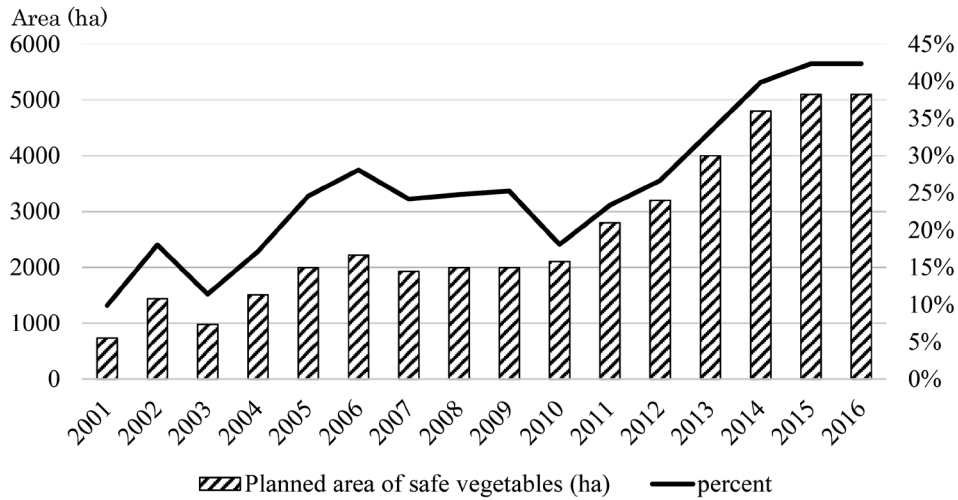


Fig. 4. Development of safe vegetables in Hanoi and its proportion of total vegetables area
 Source: Summary from Hanoi Department of Plant Protection (2016), Tam (2010).

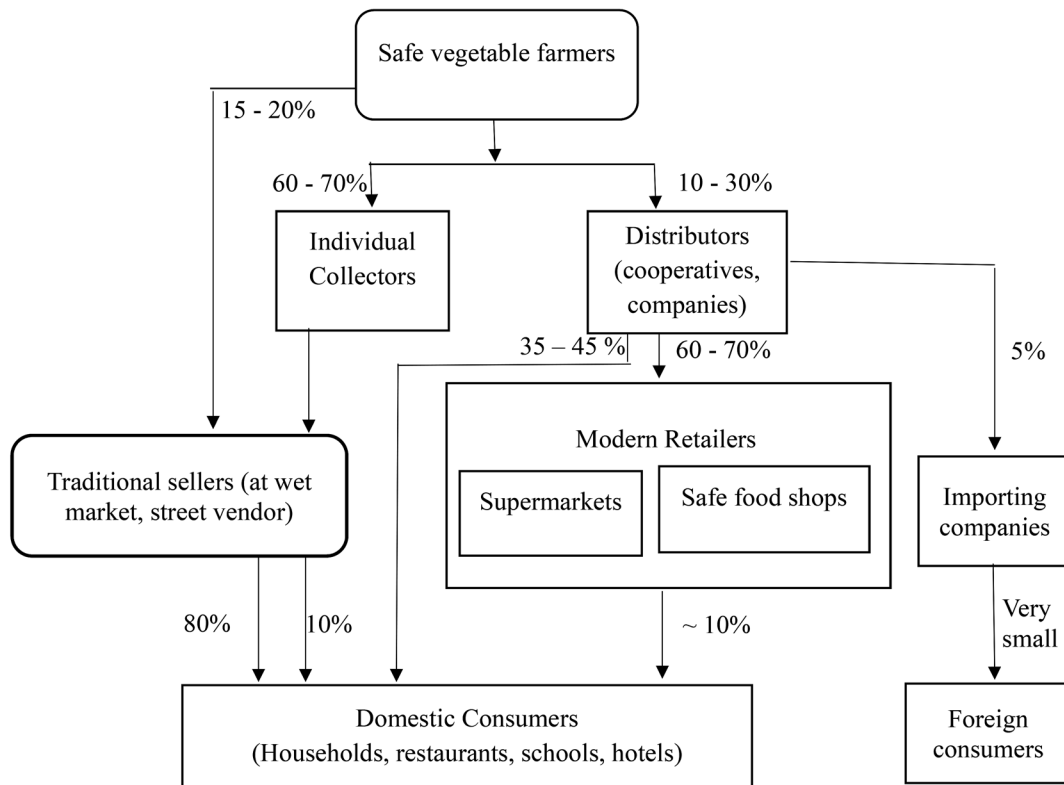


Fig. 5. Distribution channels and market share (% in terms of quantity proportion) of safe vegetables in Hanoi.
 Source: Our survey (2018, 2019)

Compared to the supply chain of safe vegetables reported by Son *et al.* (2006) (as cited in Huong *et al.*, 2013) described in Fig. 6, our distribution channel separated the proportion of safe vegetables distributed through modern retailing system from that of traditional markets. Meanwhile, we did not see the proportion of safe vegetables sold to traditional markets in the work of Huong *et al.* (2013), which seems to infer that the whole safe vegetables were distributed to supermarkets/shops. Perhaps, their approach was not based on each supply

chain, so it may fail to estimate such proportions. The discrimination about proportion of safe vegetable quantity distributed between modern retailing system and traditional markets is very important as price premium and brand of safe vegetables only exist in modern retailers.

In addition, our updated data shows that individual collectors (local collectors) distributed 60–70% of safe vegetable quantity in whole channel, which is very much higher compared to 2% in the findings of Van Hoi *et al.*

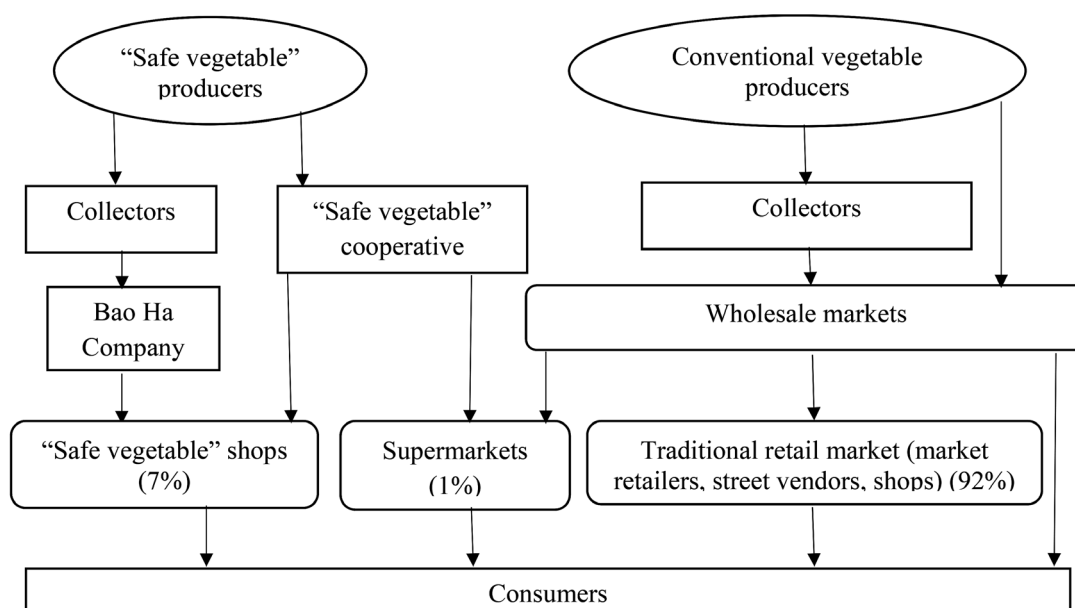


Fig. 6. Marketing channels and market share (%) for vegetables in urban Hanoi in 2006. Figure was built by Huong *et al.* (2013), which was adapted from original work of Son *et al.* (2006).

Table 2. Changes in selling price of safe vegetables from producers to other stakeholders

Farmer ID	Area (m ²)	Major vegetable	Selling places (Proportion of quantity)	Selling prices (VND/kg)	Date of price set	Reference price at AEON*
#1	432	Cabbage	Local collectors (85%) Local market (15%)	To collector: 5,500 Local market: 4,000 – 6,000	One day before Daily	10,000
#2	1,000	Tomato	Local collectors (100%)	11,000 – 13,000	One day before	19,000
#3	1,800	Chinese cabbage	Van Duc cooperative (20%) Local collectors (80%)	To the cooperative: 7,500 To local collector: 6,000	2–3 days before One day before	11,500
#4	720	Tomato	Local collectors (80%) Local market (20%)	To local collector: 12,000 To local market: 13,000	One day before Daily	19,000
#5	1,400	Baro (Poireau) onion	Local collectors (85%) Restaurant (15%)	To local collector: 13,000 To restaurant: 15,000	One day before One day before	Not available

Source: Our survey from in-depth interviews of farmers and direct observation at supermarkets (2019)

(2009). Whereas, proportion of safe vegetable distributed by cooperatives was only 10–20%, which is much lower compared to 85% in the estimation of Van Hoi *et al.* (2009). These big differences can be explained by two main reasons. First, area for safe vegetables increased over 2.5 times between 2009 and 2019, from around 2,000ha up to 5,100 ha, whereas capability of cooperatives in distributing safe vegetables may be stable. This leads to decreasing proportion of safe vegetable quantity performed through such cooperatives. Second, numbers of local collectors tend to increase rapidly in order to collect large remaining of safe vegetables that cannot sold to cooperatives.

Changes in selling prices from farmers to other

stakeholders in supply chain in a typical case study at Van Duc commune, Gia Lam district, Hanoi city were presented in Table 2. Notably, almost safe vegetables were distributed to the market by local collectors. Generally, only one of five farmers received the highest price when selling to Van Duc cooperative. Meanwhile, selling prices to local collectors normally were set to be low, even lower to those in traditional markets. Moreover, a significant difference in selling prices was observed between local markets and AEON supermarkets. However this gap in such prices is normally changed by seasons and types of vegetables. While the prices of vegetables in supermarkets are often set stable over time, there were frequent fluctuations in vegetable

prices in traditional markets, which was based on supply and demand correlation. In some cases, prices of vegetables in traditional markets may be the same, even higher compared to those in supermarkets.

Safe vegetable farmers

We reported problems facing safe vegetable growers in Van Duc commune based on open questions to elicit farmers' opinions/understanding. For example, the sample question is "In your opinion, what are the most difficulties/problem in safe vegetables production" or "What are the most difficulties in selling safe vegetables you have to face?". Results show that the most problems in selling safe vegetables are low prices and unstable. Reasons behind the answers can be partly explained through the farmers' following statements.

"We have to sell almost safe vegetables to local collectors with the same prices as conventional counterparts, even lower. For example, my family sold cabbages in the past autumn season (early March 2019) to the local collectors at the price of 5,500 VND per kilogram. Meanwhile, the price of conventional vegetables at one open market in Hanoi I knew is around 6,000 to 7,000 VND per kilogram (Farmer #1)".

"Sometimes, when our quantity of safe vegetables is high due to suitable weather, the collectors try to force us to sell at considerably low prices that actually make us worse off (Farmers #1, 2, 4)".

"I and my husband grown 3.5 sao (1,000 m²) of safe vegetables. We cannot bring the whole quantity to sell directly at the local open market by using the moto-bike. So we sell them to local collectors who can buy big amount by their own small truck to carry vegetables. We can easily communicate about the price and quantity. I trust them as they resides in our commune (Farmer #2)".

"We want to sell our safe vegetables to Van Duc cooperative because the prices are stable and often higher compared to selling to local collectors or traditional markets. But the cooperative gathers only small quantity. Meanwhile, we cannot sell to supermarkets or food shops when they require a legal entity status and a stable quantity of safe vegetables (Farmer #3)".

When asked about problems in safe vegetable production, farmers said that the quality of pesticide or fertilizer in the market is somewhat bad, even they feel fake/counterfeit inputs. Besides, impact of insects and diseases on vegetables becomes more serious, which stressed that use of plant protection drugs seems less efficient (the phenomenon called resistance to plant protection drugs). Another problem was that farmers had no capacity to invest cooling system to store fresh safe vegetables.

Van Duc cooperative

Business activities (mainly related to distributing safe vegetables to the market) are limited due to the

shortage of capital amount from the members. The cooperative wants to expand the size but the most difficult problem is limited in accessing modern retailers such as supermarkets and food shops. In fact, some years ago they had relationships with some supermarkets including Big C, Metro, Vinmart, and AEON Mall. However, now they just only distribute to one supermarket, AEON Mall. Therefore, they try to access food shops, restaurants, distribution companies and export. The reasons leading to some contracts with above supermarkets broken were described as follows from the in-depth interview with the cooperative manager.

"As the manager of cooperative and also a safe vegetable farmer in a long time, I know that the big problem hindering market share of safe vegetables is from the trust of consumers. They still doubt in the safety of safely branded vegetables. Some consumers think that they are the same with conventional ones, but higher prices."

"Currently, the most important things is lack of trusts/reliabilities among partners in the value chain of safe vegetables, not only from consumers. For instance, some supermarkets as our previous customers want the cooperative to reduce the price of safe vegetables while the market price is still stable. They want to maximize their profit without caring our cooperatives and farmers' benefits. This lead to the broken cases as above described."

"We have built a reliable brand of safe vegetables. And some outside farmers (even farmers who grown conventional vegetables) used fake brand name to stick their products and sold to the market as Van Duc safe vegetables. This is responsibility of local government in controlling and inspecting food distribution."

In addition, the manager also said some problems in the safe vegetable production.

"State management in pesticide and chemical fertilizer distribution is inefficient. We do not have clear evidences, but based on farmer's opinion and my own experience, we think that the quality of pesticides and chemical fertilizers are degraded, even fake/counterfeit drugs. Insects that are harmful to vegetables are not efficiently killed in spite of using as the producer guideline correctly"

"Our cooperative has organized many training courses and extension services for farmers to produce safe vegetables. We also control the farmers' uses of pesticides, fertilizers and other plant protection drugs very strictly. However, some farmers/members do not use our suggested brands of pesticide or fertilizers that are more prestigious, they choose lower prices of other drugs that we cannot assure the quality."

Local collectors

Although local collectors are responsible for distributing a large proportion of safe vegetables in Van Duc

commune, almost the products are sold to traditional markets at the same prices compared to conventional ones. Because of very small sizes of gathering and distributing safe vegetables, each local collectors cannot access supermarkets and food shops because they have no official legal entity as an organization. These small collectors also have to face big pressure in selling safe vegetables in short times when they have only small-size cooling storage systems. In general, the local collectors feel comfortable and satisfied the oral relationships (mainly based on the trust among local citizens through direct/indirect acquaintance) with local farmers.

“I can sell some vegetables to restaurants, hotels and schools in urban districts of Hanoi city. However its proportion is small due to modest demands and we also have to fiercely compete with other providers such as other cooperatives, shops or other collectors”.

“I have bought safe vegetables from 8 to 10 farmers who I know well and place my trust on them. The price is mainly set during short time, normally one day prior to harvesting period at farm-gate. This type of transaction is convenient for both me and farmers because we can identify the price more closely to the market price.”

“Of course, sometimes I have to face risky when the prices fluctuate so much and farmers break the oral agreements. But I accept this and find other providers.”

Distribution/food companies

In-depth interview with a food company who also sell safe vegetables branded Van Duc revealed the way he/she access the market for safe vegetables. The company provides numbers of products including fresh fruits/vegetables, meats, fish. They sell 40% of safe vegetables to supermarkets/other food shops and directly distributed 60% remaining to restaurants, schools, hospitals. The customer can order the types and quantity through the company hotlines phone or through online system. The manager shared some key issues in distributing safe vegetables as described following.

“Business in safe vegetables now requires great attempt to build consumer trust in the safety. Many consumers (both individuals and hotels, restaurants, schools) are skeptic, even pessimistic about current status of food safety in the market. They tend to collect a lot of information about producers who have the most prestige to provide safe vegetables through internet, friends and other media.”

“We cannot expand quickly our business size. Only step by step to build the loyalty of consumers from providing all products (vegetables, fruits, meats and fish) with safety certification, traceability and our quality claims.”

Consumers

Based on literature review and our own research, we

can conclude that consumer trust and attitude toward the safety of safe vegetables is an important key to developing this sector. Our survey showed that only 20% of consumers who know about safe vegetables buy this product regularly, while majority of them (over 70%) buy very little. The problem is not from the price of safe vegetables as almost consumers perceived that the price is not considerably high compared to conventional counterparts. The obstacle is not also from inconvenience to purchase safe vegetables when they can access at supermarkets, shops or distribution companies: vegetables are displayed at 87 of 156 supermarkets in 2014 (Loc and Chung, 2015) and thousands of food shops/vegetables shops (Khac Lang, 2017). In recent years, the development of modern retailing system in Hanoi city (supermarkets, shops) has continuously increased, which supports for distributing safe vegetables to the consumers. From the main findings of our semi-structured, in-depth interviews of consumers and literature reviews, we can give some reasons leading to consumer distrust: (1) consumers worry so much about food safety due to risk information communication (confused about food poisoning from conventional or safe vegetables; conflicting statistics about samples of vegetables contaminated by pesticide, fertilizer or biological factors); (2) They doubt the safety of safe vegetables; for instance they received news about fake/counterfeit safe vegetables displayed in supermarkets on public media; (3) They distrust producers and retailers: consumer thinks producers and retailers always cheat them, they perceive bad behaviors of farmers, numbers of food poisoning, number of samples overuse pesticide and growth stimulators.

Risk communication about food safety: a matrix of conflicting data about pesticides/fertilizer overuses in vegetable production

Consumers now acquire a mass volume of risk information related to vegetable pesticide/fertilizer or other chemical drugs from public media, which causes high worry or even anxiety about food safety (Nguyen-Viet *et al.*, 2017, Ha *et al.*, 2019). However, we argue that unclear or conflicting data/information related to food poisoning incidents and overuses of pesticide, fertilizer, heavy metals or growth stimulator on mass media (Television, broadcasting, internet, and newspapers) can be a major reason leading consumers confused and worried about vegetable safety in general, safe vegetable in particular. For instance, the proportion of vegetables exceeding the food safety regulation's maximum residue levels (MRLs) was over 10% in nationwide in 2015 from Ministry of Agriculture and Rural Development (MARD), which is reported by Vietnam Television (VTV, 2015). Meanwhile, a survey at 5 main areas of vegetable production (including Hanoi city, Ho Chi Minh city, Lam Dong province, Vinh Phuc province, Lao Cai province) reported this figure of 4.2% in 2015 (Tung, 2016). Especially, conflicting data appears in the same area, Hanoi city. For instance, Hong (2016) reported that only 1% of from 300 – 1,000 vegetables samples was higher

that the permitted levels of protection drugs during some recent years. Yet, this figure was up to 22.2 % in a report of MARD in 2015 (Bao Han, 2015), or even 33% by Department of Food Safety (Quoc Lap, 2015) belonging to Vietnam Ministry of Health

Based on our knowledge, the big differences on the proportion of vegetable samples over the allowed limits described above may be due to different sampling methods among various organizations or tools used to test the drug residues. Clearly, it is much different when collecting samples between conventional and safe vegetable production areas. This difference also varies when collecting samples at supermarkets or wet markets. One example shown here is about the statistics about over-uses of protection drugs in vegetable production at Lam Dong province. During 2008–2015, the proportion of vegetable sample in general exceeding the permitted levels was in average of 4.5% (with total sample was 15,249), while this was only 1.6% in 4,432 samples of safe vegetables (Lam Dong Department of Plant Protection and Cultivating, 2016). This infers a very high contaminated samples of conventional vegetables.

Local government

As described above, the capability of the state agencies responsible for food safety management is still modest. Reasons can be due to the shortage of human resource, the limitation of facilities and inspecting equipment such as food safety test kits and laboratory testing (World Bank, 2017). We provided more specific causes of inefficiency in food safety management in Hanoi city from literature reviews and in-depth interviews of the local government managers as following narratives.

“I think that it is massive obstacles in controlling the safety of vegetables from around 200,000 small-scale farmers (fragmented areas into many of small plots) in Hanoi city. In spite of our great efforts, only 30% of total safe vegetable farmers (80,000) were trained about Integrated Pest Management (IPM) which is important training course for farmers to produce safe agriculture products in Vietnam.”

“Almost safe vegetables (above 90%) are not branded, labeled or unable to check traceability, by the manager of Hanoi Plant Protection Department. The safety of vegetables at traditional channels (wet markets, street vendor) is out of control”.

“Management and control of list of pesticide and other protection drugs for vegetable production in Vietnam are still inefficient. This task needs efficient actions from central government agencies such as Ministry of Industry and Trade. Especially, increasing numbers of new plant protection drugs with many branches and various chemical ingredients have been introduced, which causes difficulties in controlling the quality of such drugs”.

CONCLUSION AND POLICY IMPLICATION

Vegetable sector in Vietnam has rapidly increased since 2010. However, the safety issues of vegetables remain highly problematic that causes great worry from domestic consumers (over 70% consumers worry) and hamper the expansion of export markets (only accounting for 1.4% of total vegetable quantity). Although the government has implemented several policies and solutions to develop safe vegetables, its achievement is very limited. Based on supply chain analysis, we find that a major proportion of safe vegetables (80% or above) is distributed to traditional markets where price premium and brand familiarity do not exist. One main reason is from low level of consumer trust placed in safe vegetables. Another reason may be from lack of strong cooperation among stakeholders in the supply chain of safe vegetables. Moreover, state management in food safety, especially in distribution and business stages, is inefficient by various obstacles. For instance, the shortages of facilities/tools and staffs, fragmentation in vegetable production, the legal regulation and mechanism to control food safety in traditional markets. Finally, a confused or even conflict risk communication about food safety can worse off consumer trust.

We propose some policy implications for expanding safe vegetables as follows. First of all, a clear, reliable and evidence-based risk communication about food safety to public is crucial. Second, the government should pay more attention to control better the distribution and business of safe vegetables and have strict punishment toward fake/counterfeit safe vegetables trading. This help to facilitate retailers and stakeholders in expanding market share and also recover consumer trust in safe vegetables. Next, stakeholders in supply chain with the government support need to build and develop strong brands of safe vegetables that can improve consumer trust in this segmentation. In addition, there is a need to strengthen the cooperation among stakeholders based on mutual reliability, information transparency and benefit sharing in the supply chain of safe vegetables. Finally, instead of trying to rapidly expand planned area for safe vegetables under the limited capability of food safety control, the local government and relevant parties (i.e. cooperatives) should manage current area of safe vegetable more efficiently.

AUTHOR CONTRIBUTIONS

Hai Minh Ngo designed the research questionnaire, collected and analyzed the data, and drafted the manuscript. Hoa Quynh Vu collected and analyzed the data, revised the manuscript draft. Ran Liu commented the research design and questionnaires, supervised data collection, provided critical suggestion on data analysis and the manuscript draft. Masahiro Moritaka commented the research design and questionnaires, supervised data collection, provided critical suggestion on data analysis and revised the manuscript draft. Susumu Fukuda commented the research design and questionnaires, super-

vised data collection, provided critical suggestion on data analysis and the manuscript draft. All authors read and approved the final manuscript.

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