



## Revealing informal food flows through free Wi-Fi Layer 3: Revealing food flows using registration forms

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## ABSTRACT

In Vietnam, wholesale and retail traditional wet markets play an important role in food marketing systems. Although market system development has been taken into account by governmental policies, the market system, especially wholesale markets, have not been well-planned.

The in-person survey was conducted among vegetable, pork and rice sellers using registration forms in 5 traditional wet markets in Hanoi, Vietnam in order to partially characterize the food flow of different actors as well as to understand physical and social characters for different foods in the flow as well as strengths and constraints in the food distribution system. The survey is one of 3 layers for data collection under the project “Revealing informal food flows through free Wi-Fi”. The results are summarized as below:

*Food quantity in the different traditional markets:* The differences are reported between peri-urban and urban retail markets as well as wholesale markets. While the average quantities of vegetables per seller per day in the urban retail markets are almost twice as high as those in the peri-urban retail markets, the volume of pork bought and sold by peri-urban retailers is notably higher than that of urban retailers. Vegetable sellers in the wholesale market are in an entirely different league when the quantities they buy and sell are much higher.

*Mapping the flow of food and food-related actors in wholesale and retail traditional markets:* Vegetable wholesalers in Hanoi dominate the input flows of the retail markets while wholesalers in other provinces dominate the input flows of the wholesale markets. Pork slaughterhouses in Hanoi are the main provider of pork to traditional markets. Rice wholesalers of the city dominate the input flows of the retail markets while mills dominate the input flows of the wholesale markets.

*Food loss in the traditional markets:* The high rates of food loss for dark green leafy vegetables in retail and wholesale markets are indicated (3.7% to 10.8% in the retail markets and 6.2% for the wholesale market for morning glory; 3.1% to 6.2% and 1.7% for different types of mustards in retail and wholesale markets, respectively).

*The strengths and challenges of the food flows that network actors face:* Traditional markets are generally most suitable to the low-income people and food products are easily accessible. However, food safety and untraceable products are of great concern for the food flows in Hanoi traditional markets.

Further exploration of this topic thereby constitutes another promising avenue of future research.

## ACKNOWLEDGEMENTS

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We thank the market management boards of 5 selected markets in Hanoi, Vietnam for their enthusiastic collaboration in the work. We express our deepest appreciation for the time and willingness of the sellers participating in the surveys that made up this study.

## 1. Introduction

In Vietnam, wholesale and retail traditional wet markets play an important role in food marketing systems, as nearly 70% of the agricultural products are distributed through these types of markets (Pham & Dao, 2016). Across Vietnam, wet markets account for 77% to 99% of urban households' food expenditures (CGFAR 2018a). The growing demand for food as well as the increasing supply of agricultural products leads to an increase in the number of enterprises in the food supply chain, especially very small and small-to-medium enterprises (Cuong, Sang & Anh 2007). Many of these food-related enterprises are informal and thus remain invisible for researchers and policy makers.

Although market system development has been taken into account by governmental policies, the market system, especially wholesale markets, have not been well-planned. This results in an increase in costs and transportation time as well as a decrease in food quality and safety and marketing opportunities, all of which influence food flows. Food flows at traditional and informal markets are largely invisible despite being the main vehicle for food access for the poor and potential source of food safety hazards. Unraveling flows contributes to identifying policy/planning options to upgrade distribution. Improving food flows cannot be undertaken simply to increase the efficiency and quantity of fresh food supply. It requires the combination of system-level solutions, collaboration amongst stakeholders, and organizational capacity building. There is, therefore, a need to study food flows in wholesale and retail wet markets to understand physical and social characteristics for different foods in the flow as well as strengths, opportunities and constraints in the food distribution system.

Most recent studies focus on a single food item using methods like semi-structured interviews, focus group discussion, surveys, etc. These data collection methods face disadvantages, for instance, the lack of accuracy of recall data. In this study, we attempt to use a citizen science approach to move from discontinuous "one point in time" data collection to semi-permanent monitoring of food flows with an emphasis of collaboration with market actors and consumers. Citizen science is an approach to undertake scientific research that engages many people to collaborate for data collection. Citizen science has been widely applied in the past two decades (Bonney et al., 2009) and data collected by citizen scientists has proved to be reliable (Nicola Mitchell et al., 2017; Aceves-Bueno, 2017).

In this study, an in-person survey was conducted among sellers using registration forms in 5 traditional wet markets in Hanoi, Vietnam. This survey was one component of the project "Revealing (informal) food flows through free Wi-Fi"<sup>1</sup> developed in response to the CGIAR Big Data Inspire Challenge<sup>2</sup>. This survey constitutes Layer 3 of the project. This report presents initial results using the database from of this layer.

## 2. Research questions

Layer 3 tries to answer parts of the following research questions:

- What are the food flows circulating in the different traditional markets?
- How to map the flow of food and food-related actors in wholesale and retail traditional markets using existing/registered data?

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<sup>1</sup> The project includes two additional layers of data: Layer 1: The Wi-Fi system keeps track of each mobile device moving in the market; and, Layer 2: Wi-Fi users provide answers to a single question each time they connect to the network.

<sup>2</sup> The CGIAR Big Data Inspire Challenge awards grants to projects using "new methods to create data driven insights for policies in agriculture and food"



- What are the strengths and challenges of the food flows that network actors face? How can possible innovations improve these?

### 3. Methodologies and sample size selection

The 5 study markets in Hanoi include 2 urban retail markets in Cau Giay district, 2 peri-urban retail markets in Dong Anh district and 1 wholesale market in Bac Tu Liem district. These markets were selected to capture data from typical urban and peri-urban markets. The markets are well-established in Hanoi and have been featured in previous CIAT research before (A4NH benchmark sites). The selected wholesale market supplies a large volume of products to target retail markets.

**Table 1. Information of selected markets**

Market	Location	Type of markets	Total No. of stores	No. of food stores	Of which						
					Rice, sugar, milk*	Vege.	Fruit	Dried foods	Poultry	Pork	Others
Nghia Tan	Urban Cau Giay	Retail	186	85	24 (4)	32	15	26	8	15	275
Dong Xa	Urban Cau Giay	Retail	440	165	5 (2)	35	25	24	4	21	105
To	Peri-urban Dong Anh	Retail	280	52	9 (2)	7	6	1	2	23	-
Trung Tam	Peri-urban Dong Anh	Retail	121	72	10 (3)	11	11	3	8	16	-
Minh Khai	Urban Bac Tu Liem	Wholesale	900	900	(3)	622	1	2	70	40	-

\*Note: Number in a parenthesis is the number of rice stores.

**Figure 1. Location of selected markets**



For Layer 3 we collaborated closely with the Market Management Boards (MMBs) of the 5 selected markets to implement a weekly panel survey from August 2019 to February 2020 with roughly 120 food-sellers of different main products. Focus group discussions were conducted in June 2020 to validate results (focusing on vegetables for food groups providing vitamins, pork for food groups

providing protein, rice for food groups providing carbohydrate) to get a better picture of survey results. We employed a citizen science approach with the goal of getting market actors' collaboration in the survey. In the study, vendors filled in weekly registration forms. In order to ensure consistency, the data was reported at a certain time and at a certain day of the week. As the sellers were required to report data weekly over a long time, collaboration from MMBs and sellers played an important role.

**Table 2. Numbers of vegetable, pork, rice sellers by market types**

Market type	Vegetables seller	Pork seller	Rice seller	Total
Urban – retail	21	15	3	39
Peri-urban - retail	20	25	5	50
Wholesale	25	6	2	31
Total	66	44	10	120

The numbers of vendors sampled over different product-categories was determined prior to data collection based on the respective shares of these vendor-types in each individual market. In order to ensure the representativeness of different vendors in terms of store locations in each market, especially for vegetables and pork, we selected vendors that are equally located (e.g. for each retail market selecting one vendor every 1-2 stores).

In addition to general information on vegetables, different specific vegetables were selected based on their presence in the General Statistics Office's vegetable price-basket. These vegetables account for the largest share of the total volume sold in the markets (up to 70%), are mainly common vegetables sold year round, and frequently consumed. A number of vegetables were selected as they are categorized as nutrient dense vegetables, such as morning glory, different types of mustards, carrot, and pumpkin.

**Table 3. List of selected vegetables**

No.	Vegetables	Scientific name	Seasonality	Note
1	Morning glory	<i>Ipomoea aquatica</i> Forssk.	Year round, peak may-jun	Rich in nutrition
2	Mustards (leafy) in all kinds	<i>Brassicaceae</i>	Year round	Rich in nutrition
3	Wax gourd, Bottle gourd	<i>Benincasa hispida</i> <i>Lagenaria siceraria</i> . Mol	Year round	
4	Cucumber	<i>Cucumis sativus</i> . L	Year round	
5	Tomato	<i>Lycopersicon lycopersicum</i> L.	Year round	Very frequently consumed by all households
6	Carrot	<i>Daucus carota</i> L.	Year round	Vitamin A rich vegetable
7	Common bean	<i>Phaseolus vulgaris</i> L	Year round	Legumes
8	Pumpkin	<i>Cucurbita maxima</i> Duchesne	Year round	Vitamin A rich vegetable
9	Onion	<i>Allium cepa</i> L.	Year round	Consumed frequently
10	Cabbage	<i>Brassica oleraceae</i> var. capitata L.	Year round	Consumed frequently

## 4. Findings

The findings of Layer 3 are structured as follows to provide answers to the research questions. Sections 4.1, 4.2, and 4.3 provide results on food flows circulating in the different traditional markets on vegetable, pork, and rice, respectively. Section 4.4 presents strengths and weaknesses of the food flows in traditional markets. In Section 5 we discuss the findings of the Layer 3 surveys and focus groups.



Research question	Section				
	4.1 Vegetable	4.2 Pork	4.3 Rice	4.4 Strength and weakness	5. Discussion
What are the food flows circulating in the different traditional markets?	x	x	X		
How to map the flow of food and food-related actors in wholesale and retail traditional markets year-round using existing/registered data	x	x	X		
What are the strengths and challenges of the food flows that network actors face? How can possible innovations attend these?				x	x

## 4.1. Vegetables

### 4.1.1. Total vegetable sales and value

The average quantities of vegetables per seller per day in the urban markets are almost twice as high as those in the peri-urban markets (Table 4). However, the variation between the vendors is also much larger for these urban markets, as can be seen from the standard-deviation between retailers. When looking at the deviation for the individual vendors over time (SD within) we see that it is much smaller and much more similar for urban and peri-urban vendors: on average the quantity they buy and sell varies by a maximum of around 30-50 kilos. Vegetable sellers in the wholesale market are clearly in an entirely different league when it comes to the quantities they buy and sell.

**Table 4. Volume of vegetables in and out per seller per day by market type**

Market type	Total volume in within the day (kg)			Total volume out within the day (kg)			N/n
	Mean	SD between	SD within	Mean	SD between	SD within	
Urban - retail	163.7	165.9	56.3	156.6	161.5	50.3	296 / 14
Peri-urban - retail	58.9	45.8	33.3	54.9	40.9	26.9	473 / 24
Wholesale	2233.1	1777.8	416.7	2210.8	1769.6	475.9	448 / 18

*Note: SD = Standard Deviation, N = total number of responses, n = average numbers of responses per seller*

It is interesting to contrast these findings with the numbers reported by van Wijk et al (2005). They reported that, in retail markets, peri-urban vegetable sellers on average sold 23 tonnes per year, a figure that corresponds to multiplying our daily figure of 59.0 kg by 365 days, while the mean amount of vegetables sold by urban sellers was still lower than that sold by peri-urban retailers: 21 tonnes. Clearly, in our numbers we see a significantly higher level of nearly 55 tonnes a year on average. This indicates an increase in consumers' demands in urban areas in Hanoi. A large number of migrants to urban Hanoi every year together with increased income for food expenditure could be an explanation for this increase.

**Table 5. Value of vegetables in and out per seller per day by market type (million VND)**

Market type	Total value in within the day (kg)			Total value out within the day (kg)			N/n
	Mean	SD between	SD within	Mean	SD between	SD within	
Urban - retail	2.8	2.87	1.7	3.2	3.2	1.8	296 / 14
Peri-urban - retail	0.8	0.95	0.8	0.9	0.5	0.4	473 / 24
Wholesale	14.0	10.6	6.8	17.1	12.7	8.2	448 / 18

*Note: SD = Standard Deviation, N = total number of responses, n = average numbers of responses per seller.*

When analysing the total value of vegetables going in and out of the markets per seller on a daily basis, the picture is quite similar to the one described above (Table 5). One striking difference seems to be that the variation in income between urban vendors is still sizable, but less markedly so than when it concerns volume. The difference between the value of products bought by vendors in urban

and peri-urban markets is big: the mean value in peri-urban markets is less than half that in urban markets. However, it should be noted that, especially for urban retailers, other costs like market fees, taxes and transport are also likely to have risen significantly.

#### 4.1.2. Sales and prices per vegetable

Volumes of 10 specific types of vegetables being sold are shown in Table 6. Most vegetable retailers offer all of them in urban as well as in peri-urban markets. Wholesalers, on the other hand, are more specialized than retailers, as can be seen from the significantly lower number of wholesalers selling each of the vegetables. Only mustards are sold by more than half of the wholesalers. In general, the sales of all vegetables in peri-urban markets are much lower than those in urban markets. Cucumbers, carrots, common bean, pumpkin and onion seem to be marginally less available in peri-urban markets than in urban markets - both in terms of the share of sellers offering them and in volume offered. One reason could be due to the fact that Dong Anh - the peri-urban area - where 2 representative retail markets selected for the study still maintains significant agricultural land, thus a large volume of products consumed might be self-produced. Generally, though, the numbers match the picture from the household vegetable expenditure survey in that fairly equal amounts of a diverse range of vegetables are sold to customers in Hanoi (CGFAR 2018b).

**Table 6. Mean volume sold per seller per day by market type and number of sellers buying each type of vegetable**

Market type	Morning glory	Mustard in all kinds	Wax/Bottle gourd	Cucumber	Tomato	Carrot	Common bean	Pumpkin	Onion	Cabbage
<b>Urban – retail</b>										
Mean (kg)	39.7	14.1	12.9	14.7	14.4	10.2	9.9	11.3	11.8	18.5
SD	97.9	11.4	12.0	16.2	13.9	10.1	10.4	10.7	12.5	20.9
Nr. of sellers	23	23	23	23	23	23	22	23	23	23
<b>Peri-urban – retail</b>										
Mean (kg)	8.2	8.5	7.4	5.4	7.9	4.6	4.5	5.2	6.2	9.1
SD	6.8	7.6	13.0	4.4	7.5	4.2	3.7	4.5	4.8	9.0
Nr. of sellers	20	20	20	19	20	19	19	18	18	20
<b>Wholesale</b>										
Mean (kg)	263.0	1216.7	1589.5	1371.1	913.4	1061.8	504.9	1960.5	988.0	3317.5
SD	77.1	813.2	496.5	332.8	435.1	600.3	174.6	1061.5	201.0	2442.5
Nr. of sellers	3	15	1	2	7	4	3	2	6	9

SD = Standard Deviation. Each sample trimmed at the 95<sup>th</sup> percentile.

Reported purchase prices for the 10 selected vegetables are in a fairly consistent range (Table 7). Across the products, standard deviations are notably lower than for other questions in the survey. It is clear that prices for different vegetables per kg vary – with morning glory at 6,000VND per kg being clearly cheaper than common beans at 20,000VND per kg. Nonetheless, with the exception of these two products, mean buying prices for the selected vegetables lie between 12,000 and 15,000VND in urban markets, and 10,000-14,000VND in peri-urban markets. As expected, prices for wholesalers are lowest.

Comparing purchase prices to sales prices for the 10 selected vegetables, mean sales prices are consistently reported to be between 2,000 and 3,000VND higher than mean purchase prices. Margins are very similar in urban markets and peri-urban markets. Margins per kg in wholesale markets are reported to be lowest, sitting more around 1,000 to 2,500 VND/kg. Logically, given the higher quantities sold, total revenue is still significantly higher for wholesalers.

**Table 7. Mean buying prices per vegetable per kg in 1,000 VND**

Market type	Morning glory	Mustard in all kinds	Wax/Bottle gourd	Cucumber	Tomato	Carrot	Common bean	Pumpkin	Onion	Cabbage
<b>Urban – retail</b>										
Mean (kg)	6.1	13.2	14.5	13.7	15.5	11.3	16.4	11.4	11.8	11.0
SD	3.3	4.6	9.0	3.2	4.3	4.1	4.0	3.2	2.5	5.0
Nr. of obs.	392	380	390	392	392	376	377	383	391	388
<b>Peri-urban – retail</b>										
Mean (kg)	5.1	10.3	12.3	12.8	13.9	10.1	13.5	10.0	10.7	8.1
SD	2.4	3.9	2.9	2.8	4.5	2.0	3.0	1.8	1.6	2.8
Nr. of obs.	459	462	394	374	451	435	262	357	435	451
<b>Wholesale</b>										
Mean (kg)	5.4	7.2	9.4	10.6	10.4	8.6	11.5	5.6	7.5	4.1
SD	1.2	2.5	1.3	2.4	1.8	0.9	2.7	1.3	1.5	1.7
Nr. of obs.	43	242	19	38	82	68	41	38	92	121

#### 4.1.3. Flows of vegetables in Hanoi traditional markets (sources and sinks)

- Sources of vegetables

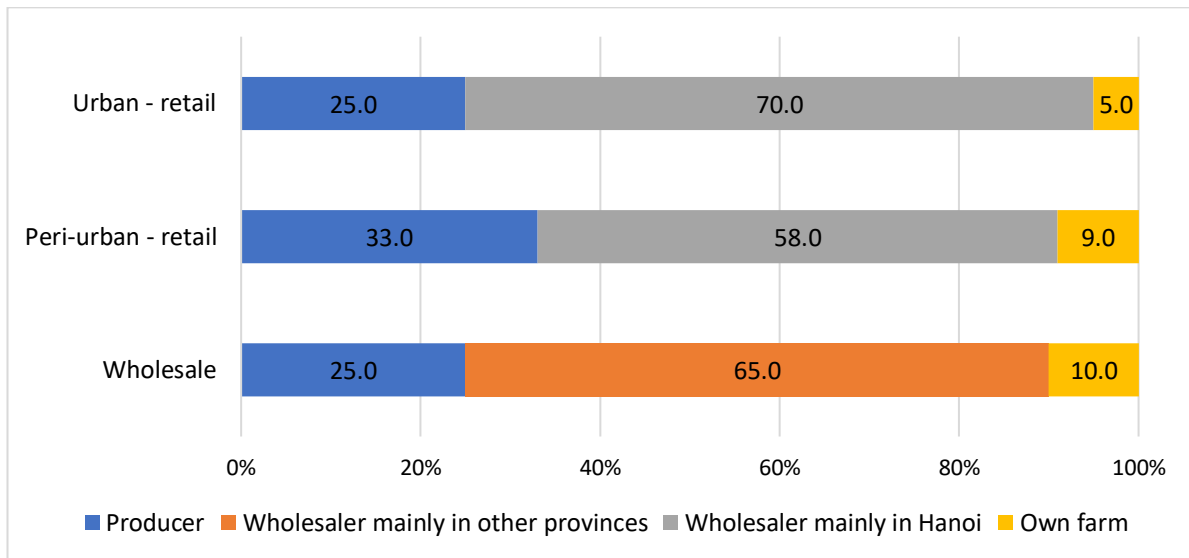
Focus group discussions with sellers and market management boards in 5 markets (Figure 2) indicate that the vegetables are sourced mainly from wholesalers in both retail and wholesale markets (58%, 70% and 65%). Nevertheless, the wholesalers who supply products to sellers in retail and wholesale markets are different. Vendors in retail markets get products mainly from wholesalers inside Hanoi and a small part from wholesalers outside Hanoi while sellers in wholesale markets get products from wholesalers mostly outside Hanoi (e.g. in Northwest provinces, Northeast provinces, Red River Delta).

In the Minh Khai wholesale market, there are two types of wholesalers (named MK wholesalers), including level 1 and level 2. Type 1 MK wholesalers number approximately 12-13 (also considered as large wholesalers) and deliver 25-30 tonnes of vegetable per night. Type 2 MK wholesalers number approximately 500 (also considered as medium wholesalers) deliver 3-7 tonnes of vegetable per night. The remaining retailers (around 100 sellers) are mobile vendors who do not have stores in the market. Many of the mobile vendors are also near-by producers. Type-1 MK wholesalers normally own big trucks and collect vegetables from distant provinces' wholesalers in Lao Cai, Son La, Bac Giang, and so on and deliver them to Type-2 MK wholesalers. Type 2 MK wholesalers both buy vegetables from Type-1 MK wholesalers and other sources.

It is interesting to note that in four retail markets in urban and peri-urban areas, there are a few vegetable sellers who sell a quite large volume of produce and also consider themselves as a retailer-cum-wholesaler in the early morning and a pure retailer in the afternoon and evening.

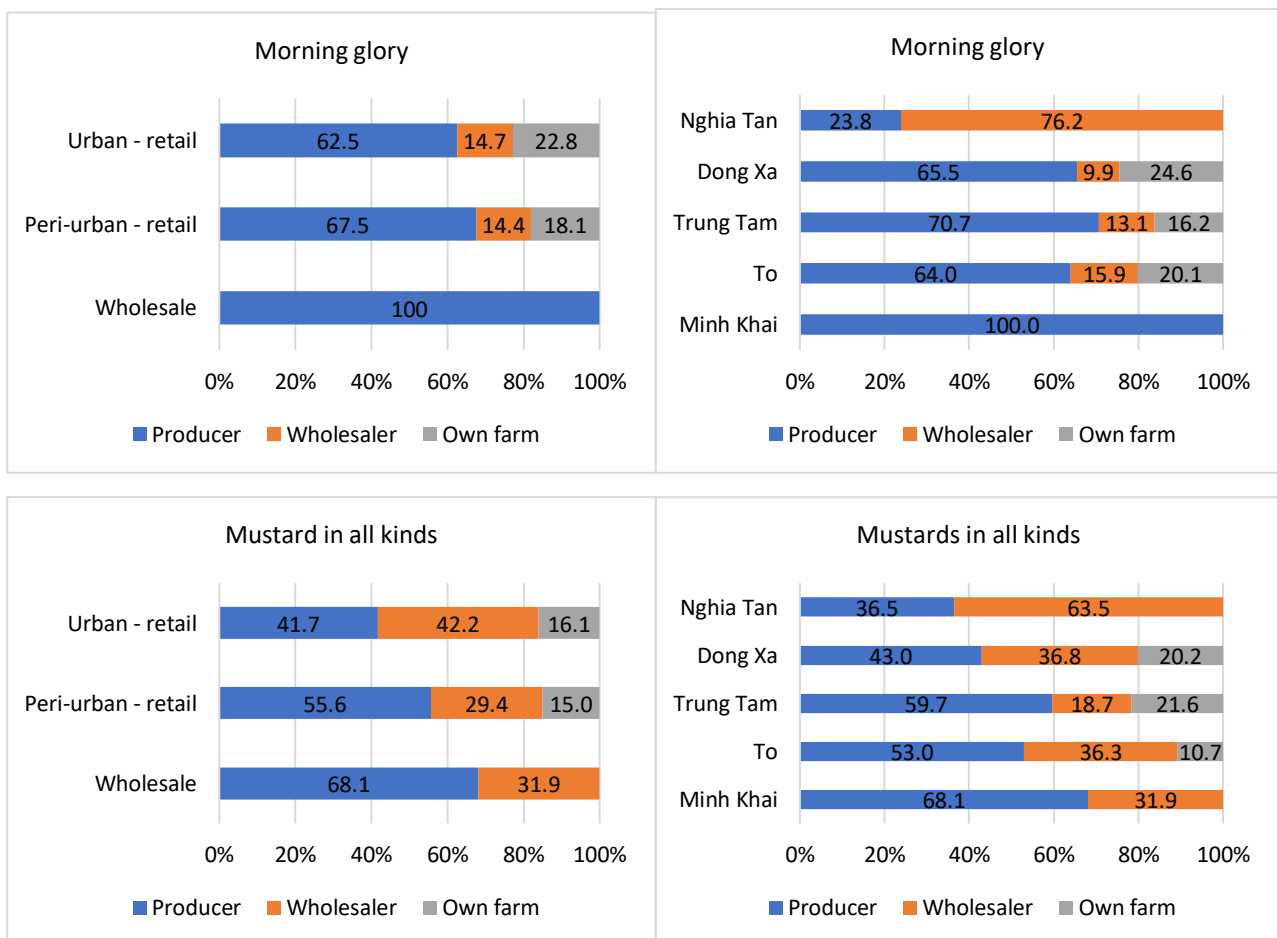
It is quite interesting and logical to note that vegetables in peri-urban markets come from producers or the vendors own farms at a higher share than those in urban markets (33% vs. 25% and 9% vs. 5%). The peri-urban areas in Hanoi are the home for vegetable production and annually sell large volumes of vegetables to urban areas, around 60% of the total demand for vegetables (Nguyen Thi Tan Loc, 2016).

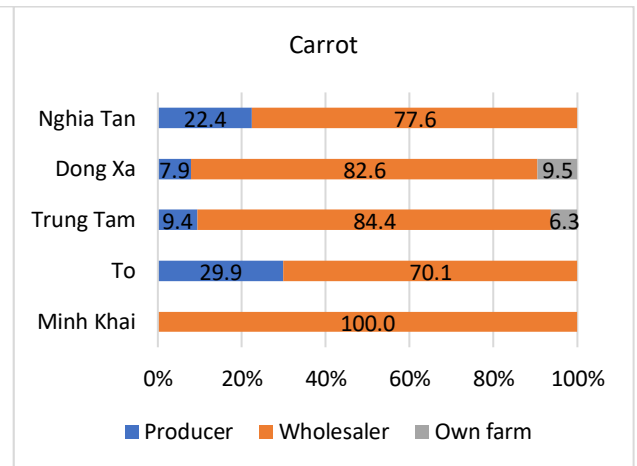
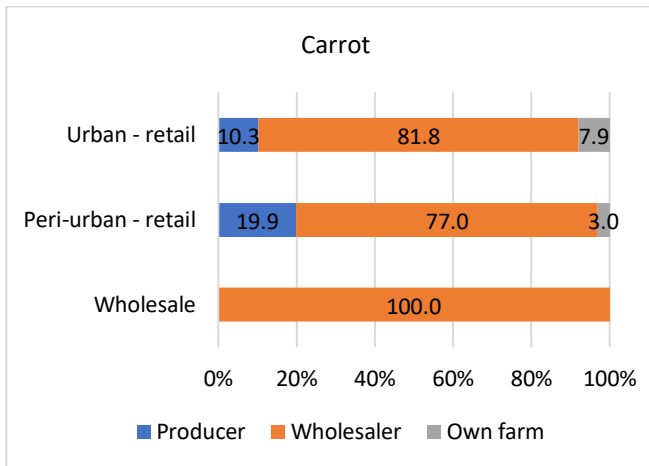
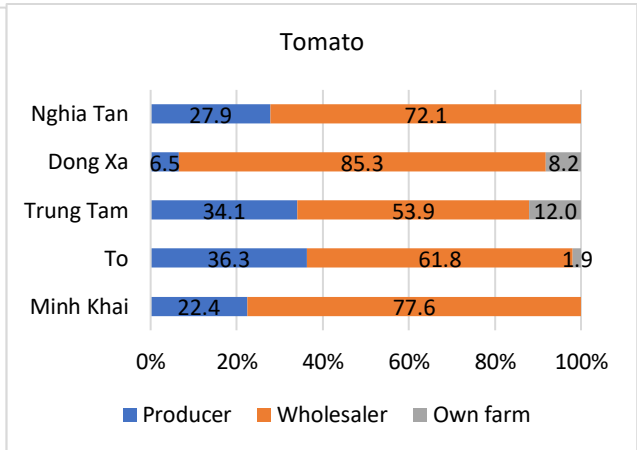
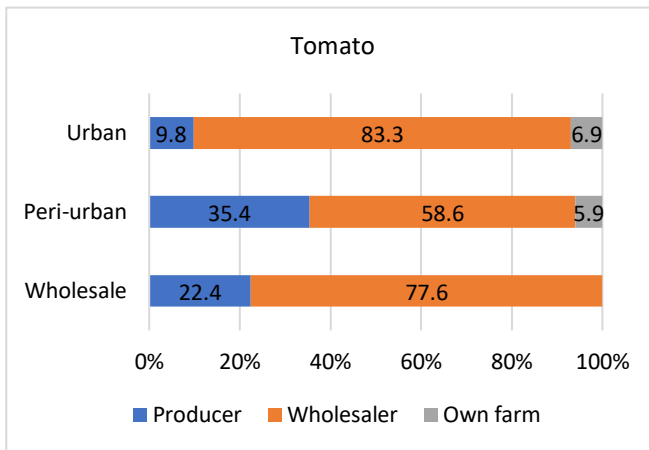
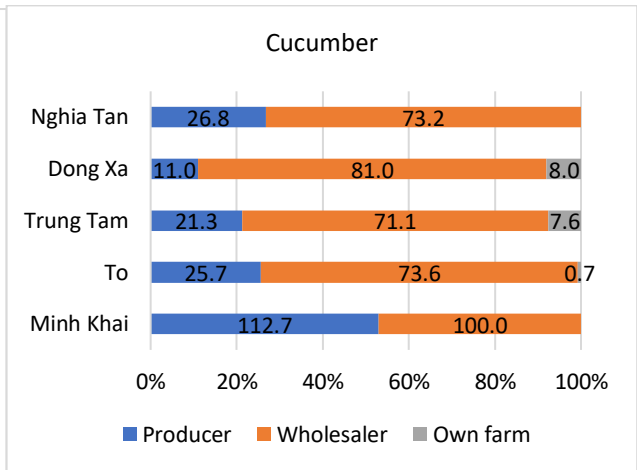
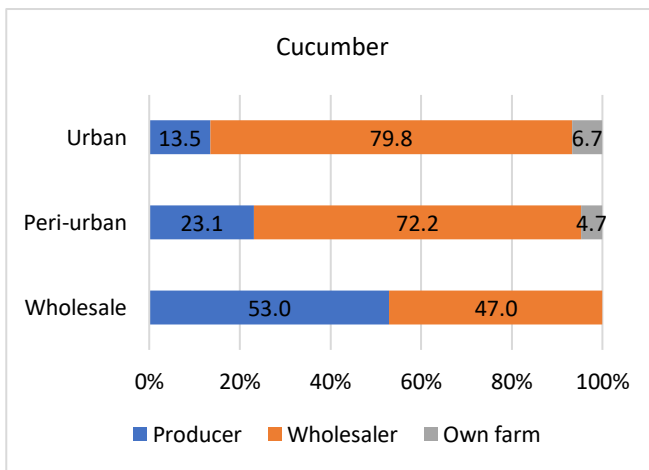
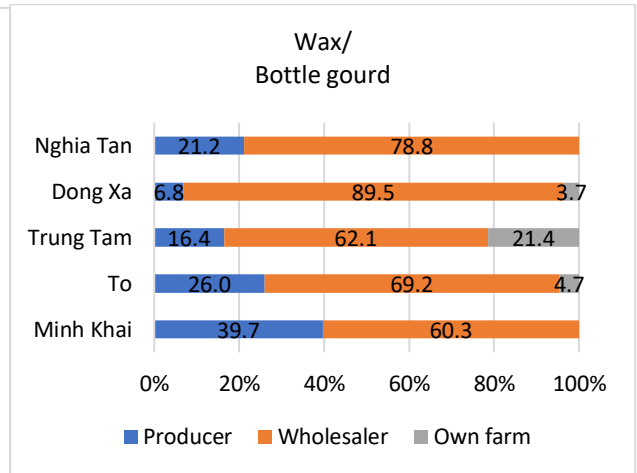
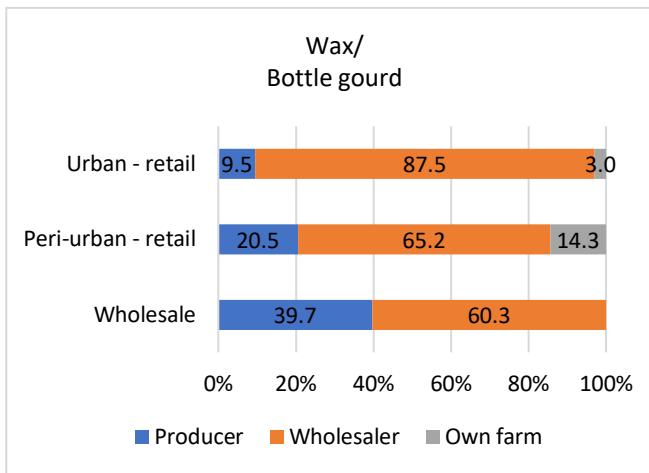
**Figure 2. Different sources of vegetables (share of total volume of vegetables purchased)**

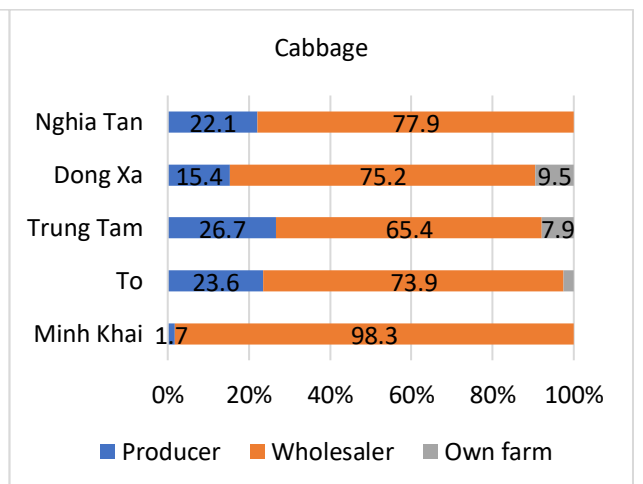
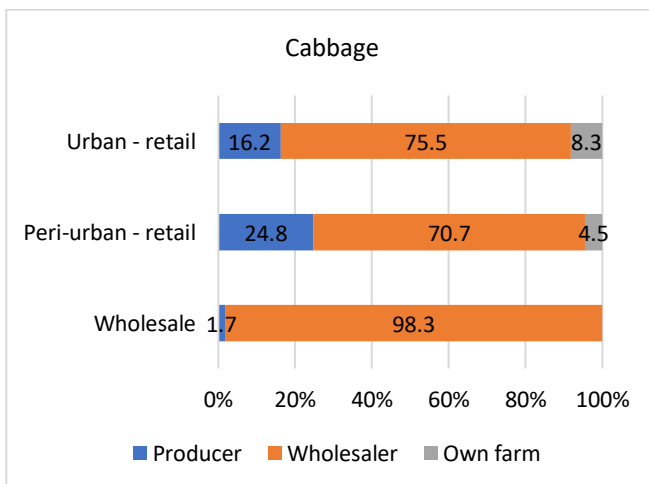
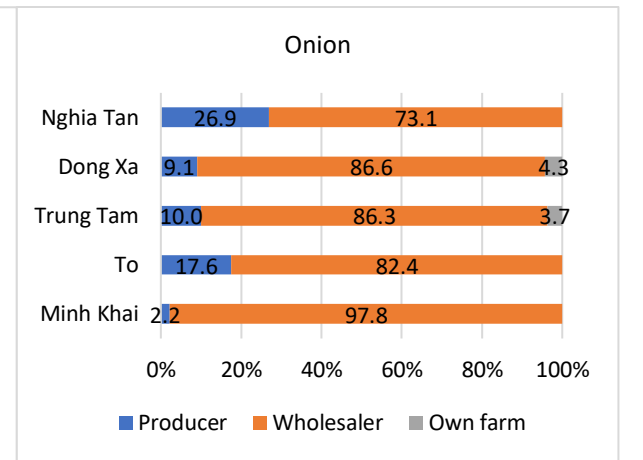
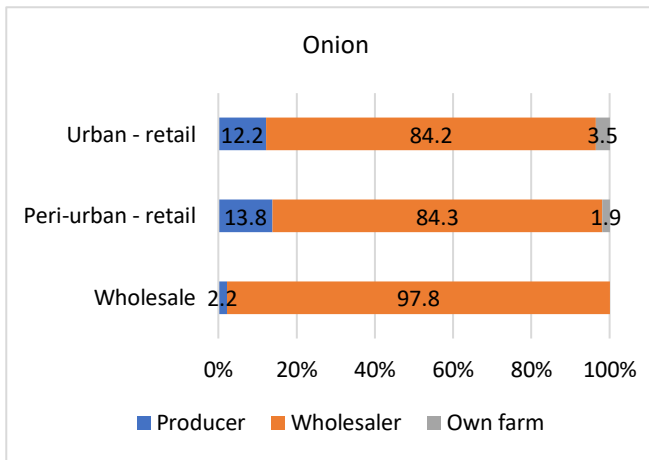
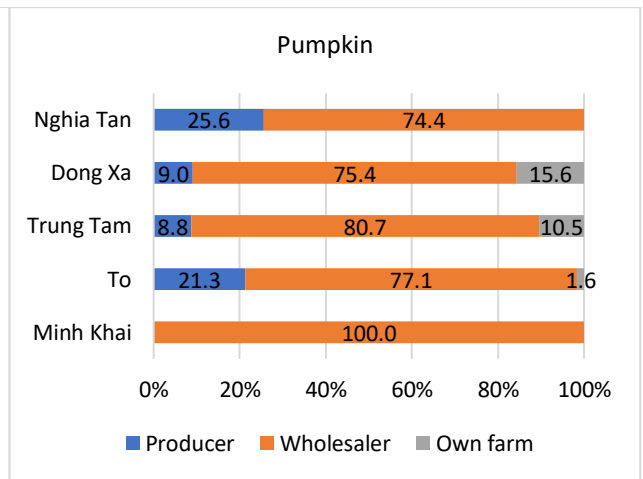
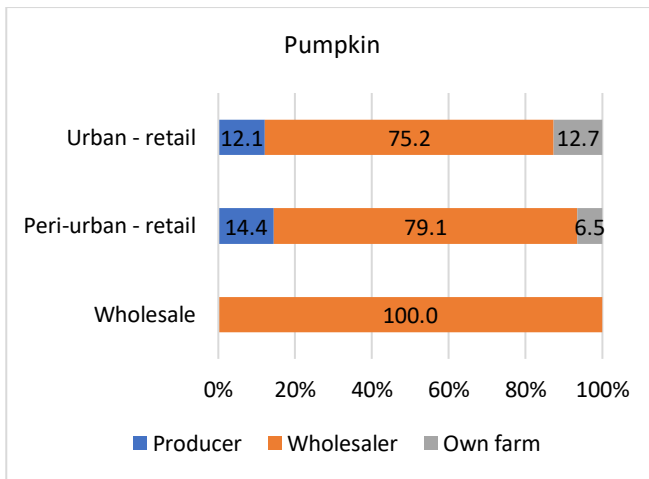
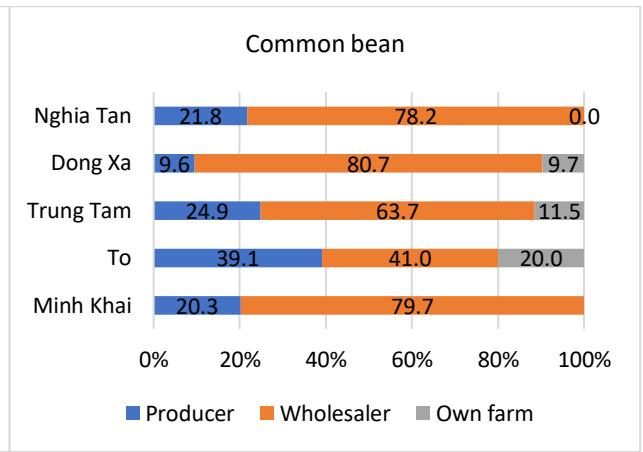
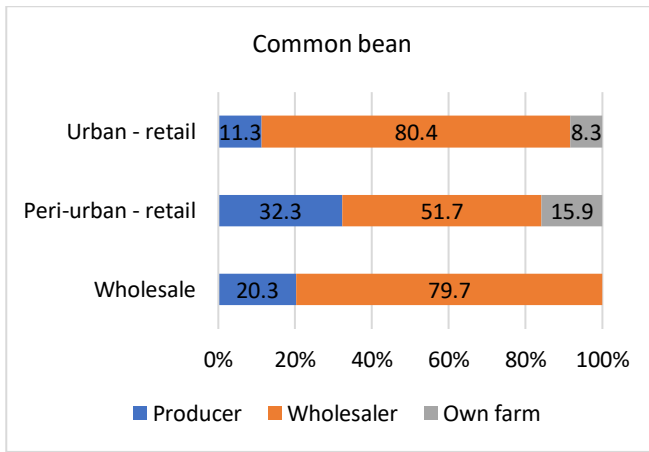


An analysis on different specific vegetables and different markets shows the difference in terms of sources (Figure 3). In retail markets, leafy vegetables like morning glory, different types of mustards, normally grown in Hanoi, come directly from producers while fruit vegetables like cucumber, carrots, tomatoes are sourced from wholesalers.

**Figure 3. Different sources of 10 selected vegetables (share of total volume of vegetables purchased)**





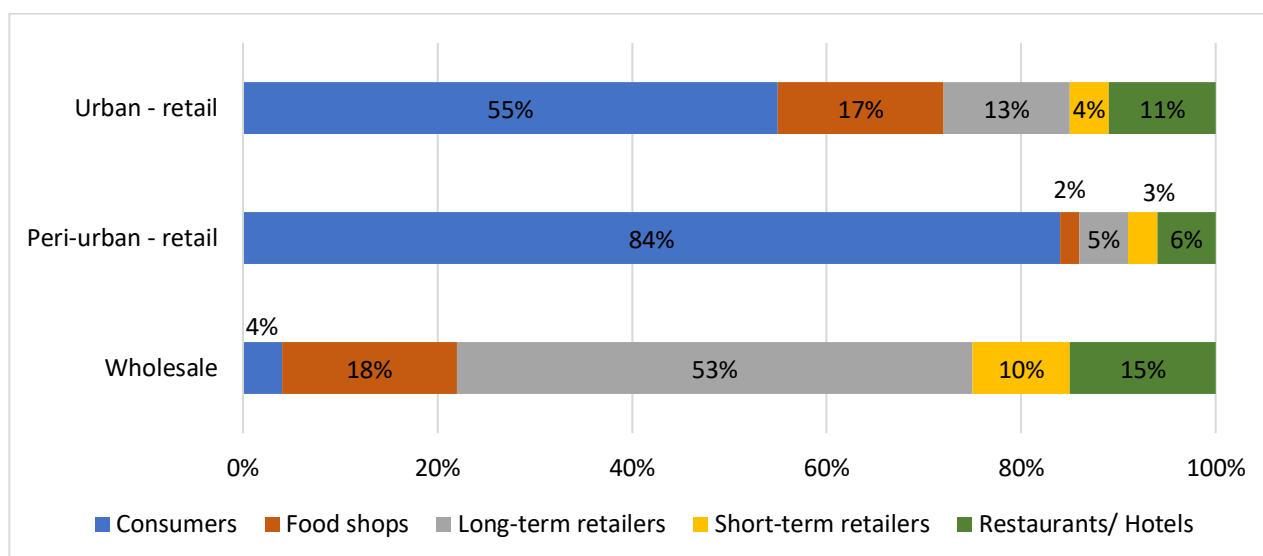




- **Customer types (food sinks)**

Consumers access the largest volume of vegetables in both urban and peri-urban retail markets (55%-84% in retail markets) (Figure 4). The peri-urban vendors sell to customers at a higher share than the urban ones (84% and 55%). Meanwhile the share of products sold directly to consumers in the wholesale market is less than 4% of each vegetable’s total volume sold. In urban areas significant amounts also go to food shops, long-term retailers and restaurants<sup>3</sup>. For peri-urban areas these shares are significantly lower, although between 5% still ends up with long-term retailers. Vendors in retail markets who consider themselves as a retailer-cum-whoseler as mentioned above deliver a large part of their products to long-term and short-term retailers as well as food shops. This might be explained by data from a previous study on food environments under A4NH indicating that the number of food shops as well as the density of food shops per 1,000 inhabitants in urban areas is much higher than that in peri-urban areas (Tuyen *et. al.* 2020). For wholesalers at least 46% of the total volume of each vegetable is sold to long-term retailers. Depending on the different wholesalers and vegetables investigated in our survey, significant amounts are also directly sold to food-shops, restaurants and hotels.

**Figure 4. Different buyer-types (share of total volume of vegetables sold)**

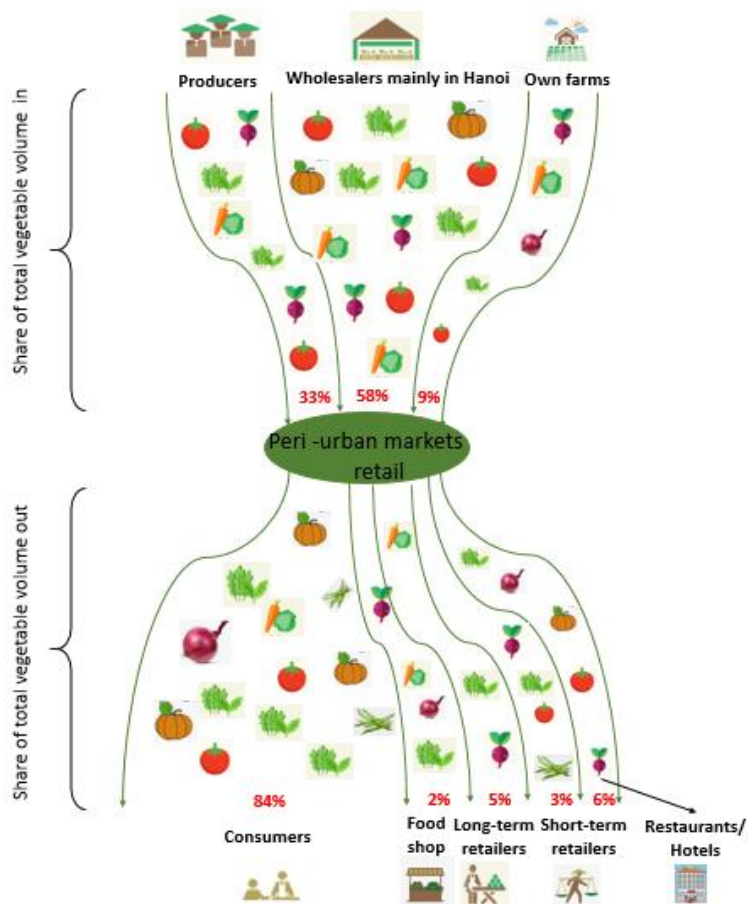
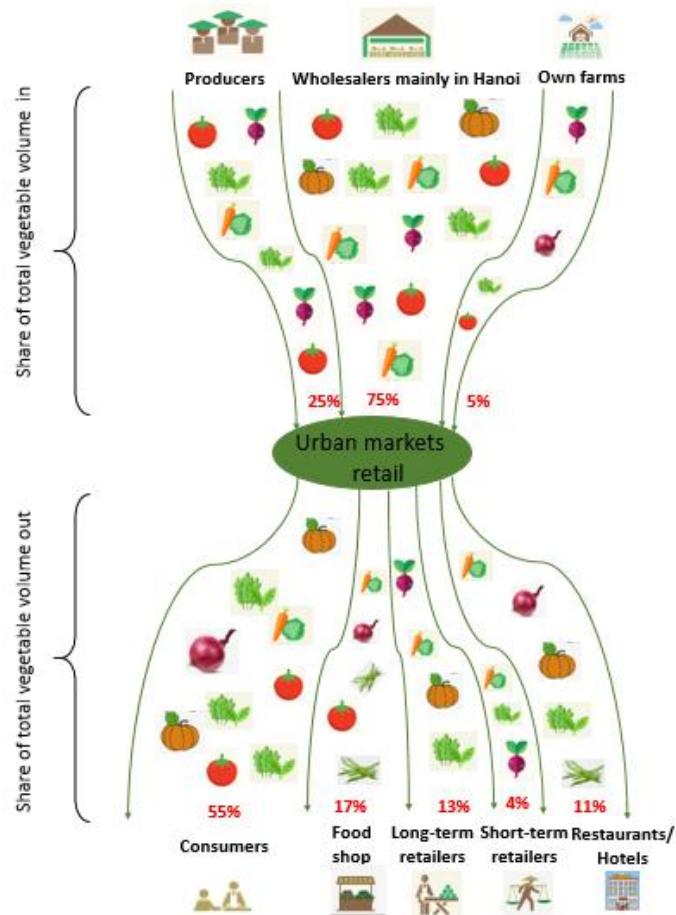


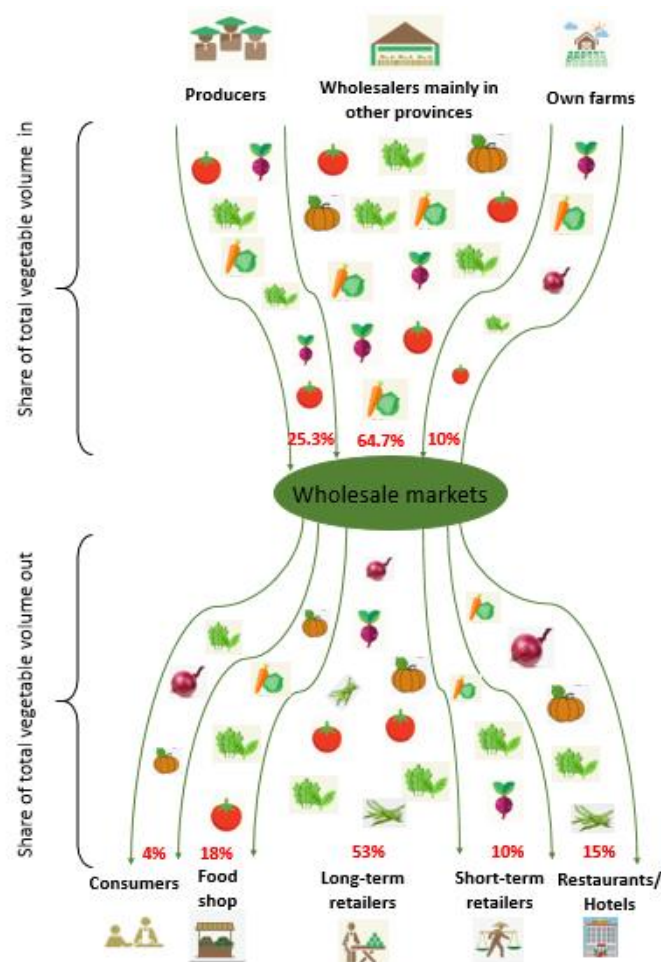
- **Flows of vegetables in Hanoi traditional markets**

The flows of vegetables are more clearly illustrated in Figure 5. Wholesalers in Hanoi dominate the input flows of the retail markets (58% to 75%) while wholesalers in other provinces dominate the input flows of the wholesale markets (~65%). In the context of food safety improvement in Vietnam, the government will prioritize the wholesale markets and propose solutions to monitor input sources.

**Figure 5. Food flows of vegetable in Hanoi traditional markets**

<sup>3</sup> Long-term retailers are sellers that own a store in the market. Short-term retailers are sellers that do not own a store in the market. They are considered mobile vendors.

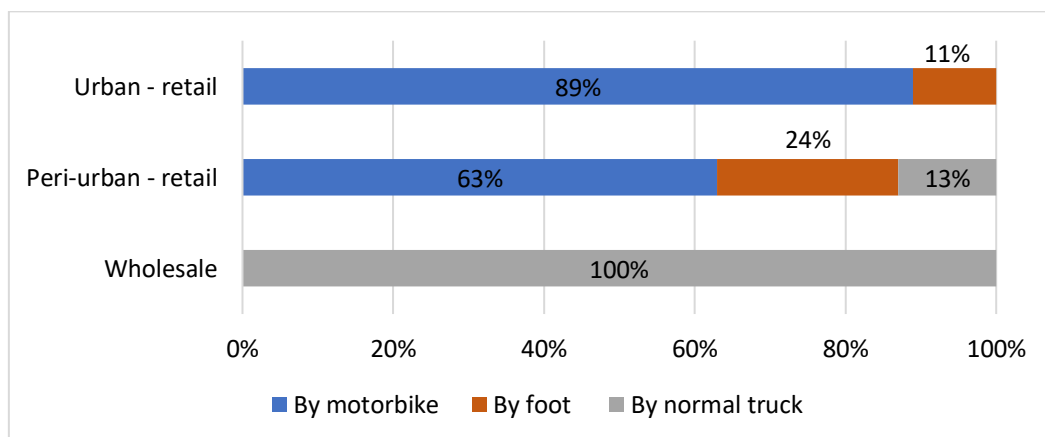




#### 4.1.4. Transportation

The mode of transportation used by vegetable vendors to transport products to the market is in most cases a motorbike. These vendors normally go to wholesale markets to buy products. Vegetables transported by foot are delivered directly by traders who bring vegetables to the markets. In peri-urban markets products are also occasionally transported by foot or bicycle, because the wholesaler is in the same market. If the products are not acquired in the same markets, the wholesaler is probably a bit further away than in case of urban markets, which explains why trucks are also used occasionally by peri-urban retailers. For wholesale markets products are virtually always transported by truck.

**Figure 6. Typical mode of vegetable transportation to market**



#### 4.1.5. Food loss

Finally, we inquired about what vendors do with products that are not sold out by the end of the day. A high number of vendors indicated that they usually sell all their products. For 40 to 50% of the cases across each vegetable type, vendors indicated that they would store the product for later sale. This issue requires further research on food loss in terms of quality. In 20 to 30% of the cases vendors replied that they sell their product at a discount when products go unsold. According to vendors and market management boards, leafy vegetables like morning glory and different kinds of mustards have higher levels of food loss while for less perishable products, the waste is unremarkable. The total of food loss per day per seller for morning glory was quite high, especially for the wholesale market (Table 8). This might be explained by the fact that the vegetables needed to be transferred over long distances from outside Hanoi or from suburban Hanoi, so the sellers still keep old leaves to protect vegetables and remove them in the market. In 2019 and 2020, the total volume of vegetables (all kinds) sold every day in the wholesale market - Minh Khai was estimated at 300-350 tonnes/day of which 8-9% was discarded.

A high rate of food loss was reported for dark green leafy vegetables in retail and wholesale markets (3.7% to 10.8% in the retail markets and 6.2% for the wholesale market for morning glory; 3.1% to 6.2% and 1.7% for different types of mustards in retail and wholesale markets, respectively). A 2019 study in Hanoi indicated that the dark green leafy vegetable food loss is approximately 3% of weekly volume at the retail level (Alliance's own data estimation, 2019<sup>4</sup>).

**Table 8. Food loss of morning glory per day per selected seller**

Market type	Market name	Food loss (kg)	% food loss to total vegetables marketed
Urban - retail	Nghia Tan	1.1	10.8
	Dong Xa	1.8	3.7
Peri-urban - retail	Trung Tam	0.7	8.4
	To	0.4	4.9
Wholesale	Minh Khai	15.9	6.2

**Table 9. Food loss of different kinds of mustards per day per selected seller**

Market type	Market name	Food loss (kg)	% food loss to total vegetables marketed
Urban - retail	Nghia Tan	0.3	3.2
	Dong Xa	0.6	4.2
Peri-urban - retail	Trung Tam	0.2	3.1
	To	0.7	6.2
Wholesale	Minh Khai	20.5	1.7

## 4.2. Pork

### 4.2.1. Total pork sales and value

Both the volume and value of pork bought and sold by peri-urban retailers is notably higher than that of urban retailers (Table 10). Also, much unlike the vegetable statistics, the variation between the mean volumes and values sold by different vendors is very similar in urban and peri-urban markets. These findings are somewhat puzzling since there is no indication that peri-urban residents consume significantly more pork than their urban counterparts (Bairagi *et. al.* 2019). A more likely explanation lies in the fact that in peri-urban areas single market actors often perform multiple functions in the supply chain (eg. butcher and retailer) (Lapar *et. al.* 2010). This makes barriers to

<sup>4</sup> Data belongs to the ongoing project of the Alliance named "Increasing fruit and vegetable intake of low-income populations in Vietnam and Nigeria through food system innovations".

entry in peri-urban markets higher both in terms of the monetary capital and supply chain network required.

**Table 10. Volume of pork in and out per seller per day by market type**

Market type	Total volume in within the day (kg)			Total volume out within the day (kg)			N/n
	Mean	SD between	SD within	Mean	SD between	SD within	
Urban - retail	36.1	34.6	23.2	36.0	22.1	26.9	302 / 19
Peri-urban - retail	58.3	22.7	9.8	58.1	22.6	9.5	611 / 25
Wholesale	289.9	96.9	75.9	289.9	96.9	75.9	68 / 17

Note: SD = Standard Deviation, N = total number of responses, n = average numbers of responses per seller

Although the mean values of pork flowing in and out of peri-urban markets are higher than those in urban markets (Table 11), the difference between value in and out is still (marginally) higher in urban markets. Higher costs in terms of market fees and transport are likely to minimise most of this difference. On the whole, the margin is largest in wholesale markets, even though it is not nearly as big as in the case of vegetable wholesalers.

**Table 11. Value of pork in and out per seller per day by market type (million VND)**

Market type	Total volume in within the day (kg)			Total volume out within the day (kg)			N/n
	Mean	SD between	SD within	Mean	SD between	SD within	
Urban - retail	2.8	1.8	1.7	3.2	1.9	0.7	302 / 19
Peri-urban - retail	4.6	2.3	1.8	5.1	2.6	1.6	611 / 25
Wholesale	20.8	8.4	6.9	22.4	9.3	8.8	68 / 17

Note: SD = Standard Deviation, N = total number of responses, n = average numbers of responses per seller

#### 4.2.2. Purchase and sales prices of pork

There is quite a big difference between the buying and selling prices reported in urban and peri-urban retail markets as opposed to wholesale markets (Table 12). The price difference might instead be explained by the relatively high costs of transport of pigs and meat to the city or more (stringent) regulation that are incorporated in the price of urban pigs and pork. These costs are likely to be transferred to retailers by wholesalers, who constitute an additional urban value-chain actor less seen in peri-urban context. For wholesalers, next to the above mentioned additional costs, it is probable that they directly supply to larger and more demanding restaurants and hotels, allowing them to set higher sales prices for some of their customers. Unfortunately, our small sample of 4 pork wholesalers does not allow us to explore this in much more detail.

**Table 12. Pork buying and selling prices (1,000 VND)**

Market type	Buying prices	Selling prices	Price difference
Urban - retail	81.2	90.6	9.4
Peri-urban - retail	80.4	88.6	8.2
Wholesale	70.0	83.2	13.2

#### 4.2.3. Flows of pork in Hanoi traditional markets (sources and sinks)

##### • Sources of pork

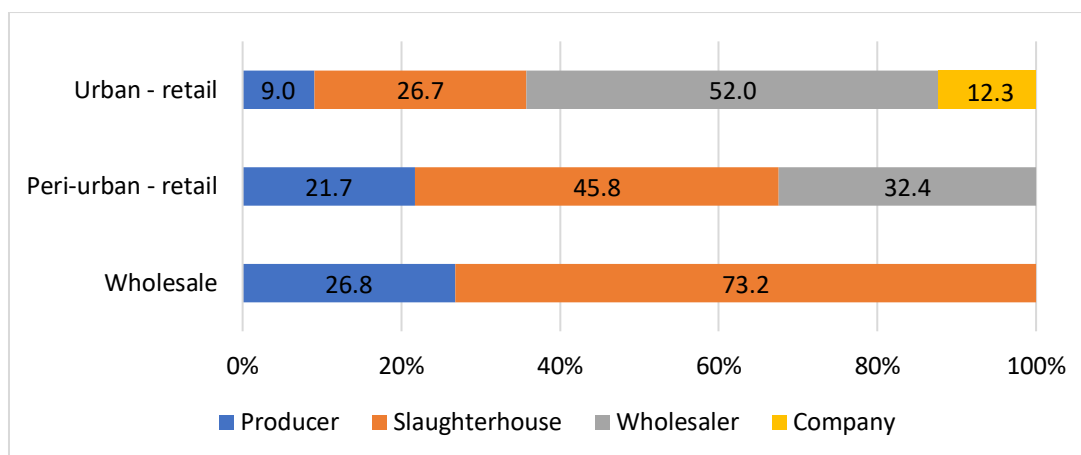
Slaughterhouses play an important role as a main source for pork supply in traditional markets in Hanoi. Nevertheless, difference in terms of different sources for pork is reported by urban, peri-urban and wholesale markets (Table 7). Compared amongst retail markets, the pork sellers in urban markets mainly buy pork from wholesalers while the pork sellers in peri-urban markets buy pork mainly from slaughterhouses. In the wholesale market, the main sources for pork are mainly

slaughterhouses and producers. Normally the pork wholesalers buy pork from slaughterhouses which increases the sales price to retailers. Some of pork is supplied from family-size slaughterhouses that are difficult to inspect and monitor for compliance with hygiene and food safety.

Notably some urban vendors have a contract to sell pork that is distributed by agencies under the CP Vietnam Corporation<sup>5</sup>. This is a new development in the pork channels in traditional markets in Hanoi to improve food safety.

As predicted before, quite a large share of pork (around 22%) comes from producers in peri-urban markets. This is explained by the fact that the peri-urban areas of Hanoi have consolidated as an important source of pork during recent years.

**Figure 7. Different sources of pork (share of total volume of pork purchased)**



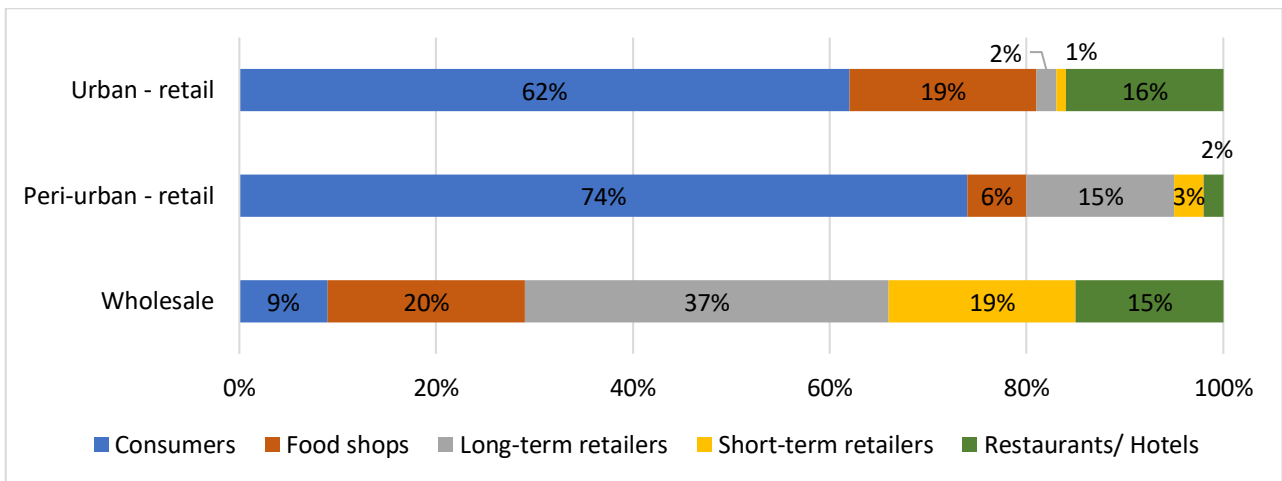
- **Customer types (food sinks)**

Like with vegetables, urban vendors sell a majority of their products to consumers, and smaller but significant shares to food shops, restaurants and hotels. Some vendors in urban retail markets play an intermediary role and deliver pork to food shops and small restaurants. The clientele of pork wholesalers also looks similar to that of vegetable wholesalers, but with larger shares going directly to consumers and short-term retailers at the cost of long-term retailers. Although peri-urban retailers sell almost ¾<sup>th</sup> of their pork to consumers, they also report selling a fair share to long-term retailers. This last observation could indicate that there are some actors that perform the role of both retailer and wholesalers in our peri-urban pork-vendor sample. This – in turn – could help to explain the high mean volume and value bought and sold in this market-category (see Table 8).

**Figure 8. Share of total volume of pork sold to different buyer-types**

<sup>5</sup> The CP Vietnam Corporation is one of the largest companies in Vietnam operating in the animal husbandry field. It belongs to the Charoen Porphand Group with its headquarter in Thailand.

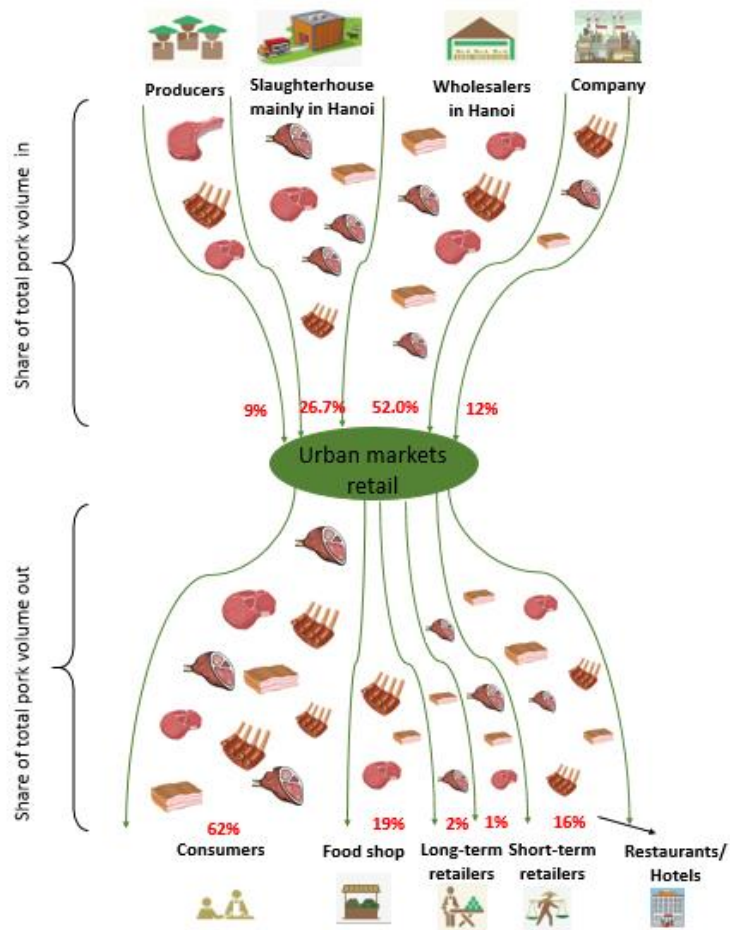


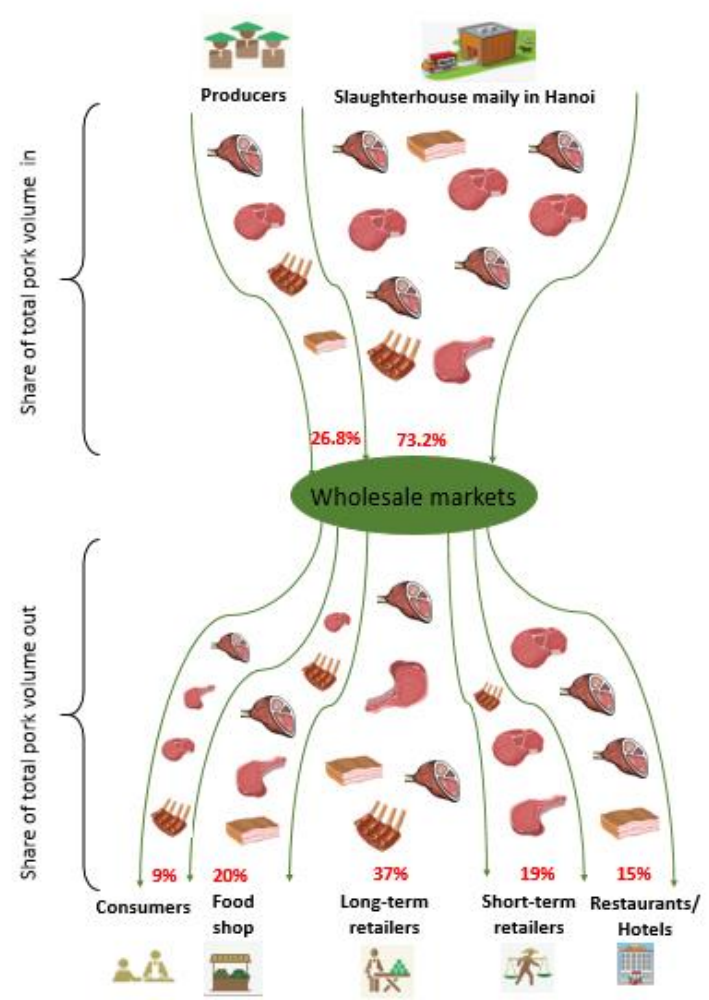
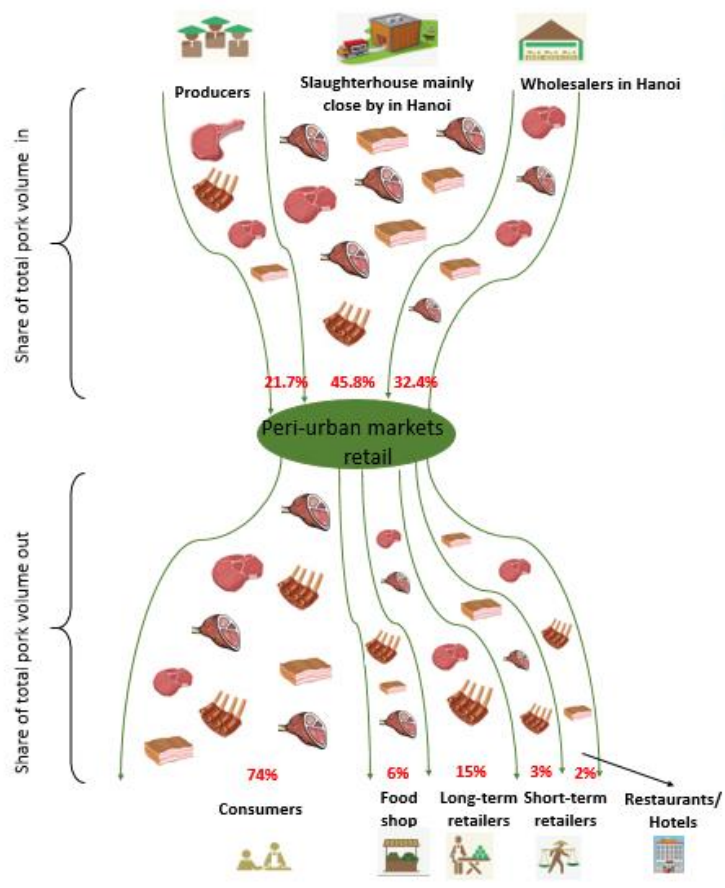


● **Flows of pork in Hanoi traditional markets**

The flows of pork are more clearly illustrated in Figure 9. Slaughterhouses in Hanoi dominate the input flows of pork to traditional markets. Weak environmental and food safety compliance in slaughterhouses serving Hanoi in recent years implies a need for improved management system for pork.

**Figure 9. Food flows of pork in Hanoi traditional markets**

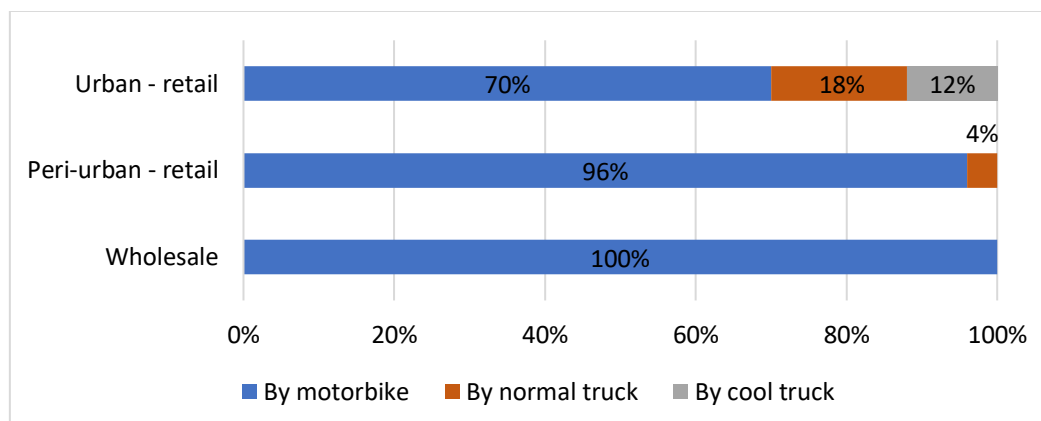




#### 4.2.4. Transportation

Pork vendors indicate that they almost exclusively use motorbikes to transport the pigs they bought. Especially in peri-urban and wholesale markets retailers rarely indicate using any other mode of transport. Only in urban markets the modes of transportation used are more diverse, with normal trucks and refrigerated trucks being used by a minority of sellers. Pork is transported by motorbike directly by retailers while pork is transported by normal or refrigerated truck by traders. In particular, for those who have a contract with the CP Vietnam Corporation<sup>6</sup>, pork is transported directly by refrigerated truck.

**Figure 10. Typical mode of pork transportation to market**



#### 4.2.5. Food loss

In terms of food loss, among pork sellers the most common way to ensure that products are fully sold is to sell the produce at a discount. Another option that was regularly chosen by pork retailers was food processing, with some sellers specifying that they take the leftovers home for their own consumption.

### 4.3. Rice

#### 4.3.1. Total rice sales

As the numbers of rice sellers in the traditional markets are small, only 2-4 per market (occupying over 50% of the total numbers of rice sellers in each), we only present initial results on volume of rice in and out and food flows. The results were validated with sellers and market management boards in 2020.

**Table 13. Volume of rice in and out per seller per week by market type**

Market type	Total volume in within the week (kg)			Total volume out within the week (kg)			N/n
	Mean	SD between	SD within	Mean	SD between	SD within	
Urban - retail	653.6	258.6	165.9	646.7	202.9	130.5	208/69
Peri-urban - retail	409.1	322.5	191.8	307.7	255.3	159.9	128/64
Wholesale	1061.1	494.8	432.5	1050.0	500.9	441.5	48/24

Note: SD = Standard Deviation, N = total number of responses, n = average numbers of responses per seller.

Due to higher demand and no rice production areas in urban areas, the average quantities of rice sold per week in urban markets are much higher than those in peri-urban markets (Table 13). According to peri-urban vendors, rice buyers in traditional markets are mainly those who are

<sup>6</sup> The CP Vietnam Corporation is one of the largest companies in Vietnam operating in the animal husbandry field. It belongs to the Charoen Porphand Group with its headquarter in Thailand.

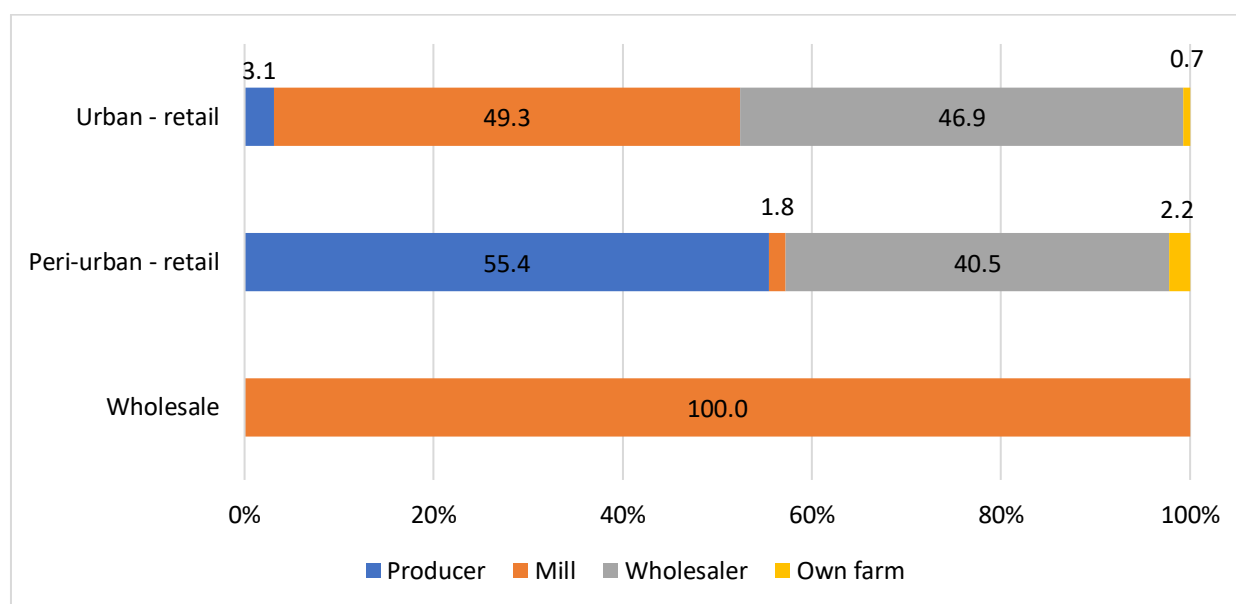
governmental staff, company workers and do not own paddy fields. Instead of buying rice in traditional markets, a large share of consumers in the peri-urban areas buy rice in their villages. Meanwhile, the average volume of rice per seller per day in the wholesale market is much higher than those in retail markets.

#### 4.3.2. Flows of rice in Hanoi traditional markets (sources and sinks)

- Sources of rice

Sources of rice in retail markets are more diverse than those in wholesale markets (Figure 11). The rice sellers in wholesale markets normally get rice from polishing mills. Compared between urban and peri-urban markets, the rice sellers in peri-urban markets mainly get rice directly from producers and wholesalers (55.4% and 40.5%) while in urban areas rice is distributed from mills and wholesalers at large packs (49.3% and 46.9%). Producers mainly come from suburban Hanoi (in the peri-urban itself and supplying around 40.0% of the total demand of Hanoi consumers) and from Red river delta provinces such as Nam Dinh and Thai Binh. This fact is in line with the figure stated by Hanoi Department of Agriculture and Rural Development (DARD) on the capacity of rice production of Hanoi in 2019. Wholesalers who supply rice to retail markets are mainly located in suburban Hanoi.

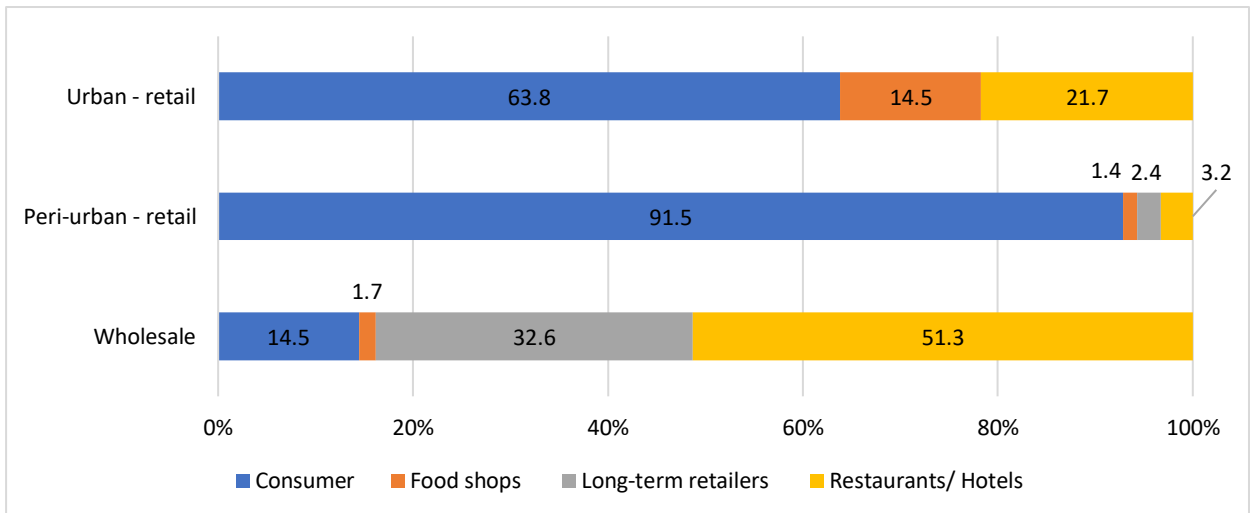
**Figure 11. Different sources of rice (share of total volume of rice bought from)**



- Consumer types (food sinks)

In the wholesale market, after getting rice from the mill, the rice vendors distribute the largest share of their products to restaurants followed by long-term retailers. In the urban and peri-urban markets, the primary buyers are still consumers, especially peri-urban areas (occupying over 90%). In urban retail markets, 21.7% of rice buyers are restaurants; however, in peri-urban areas restaurants normally get rice from the wholesale market. In general, the rice is often sold loose to consumers and packed after purchase.

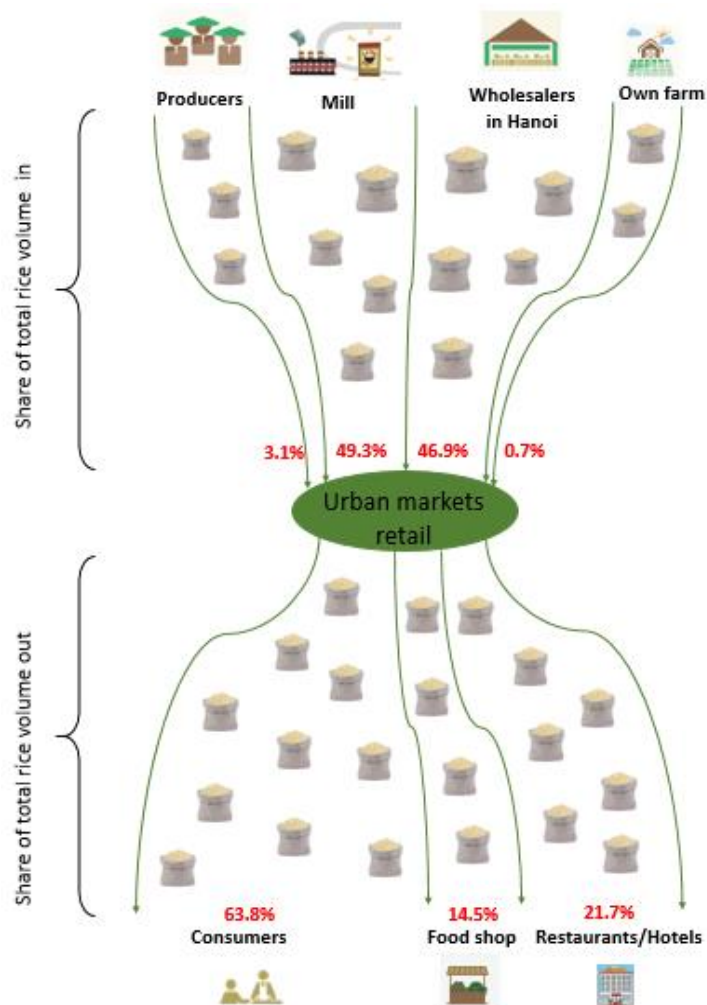
**Figure 12. Share of total volume of rice sold to different buyer-types**

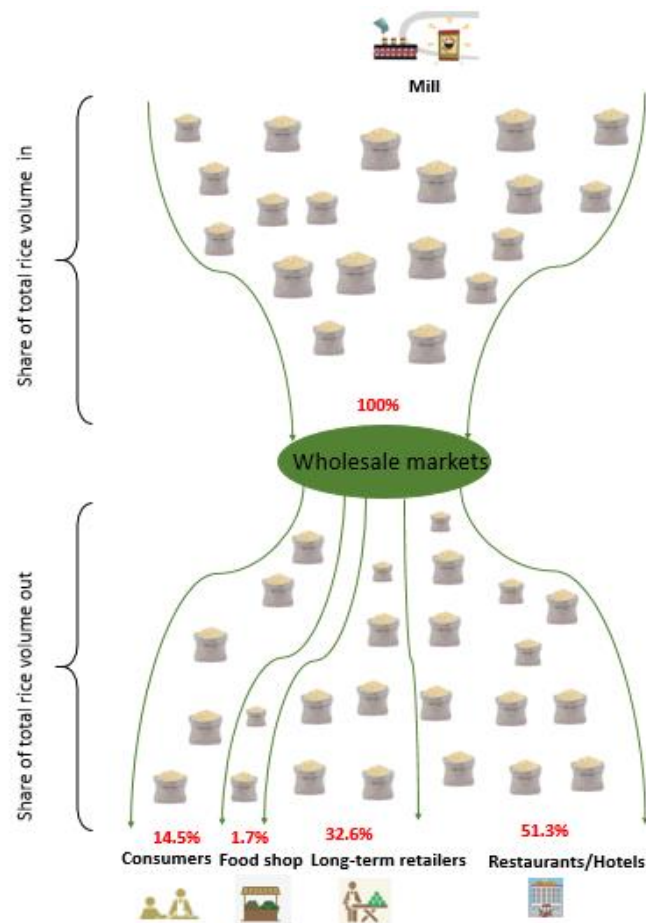
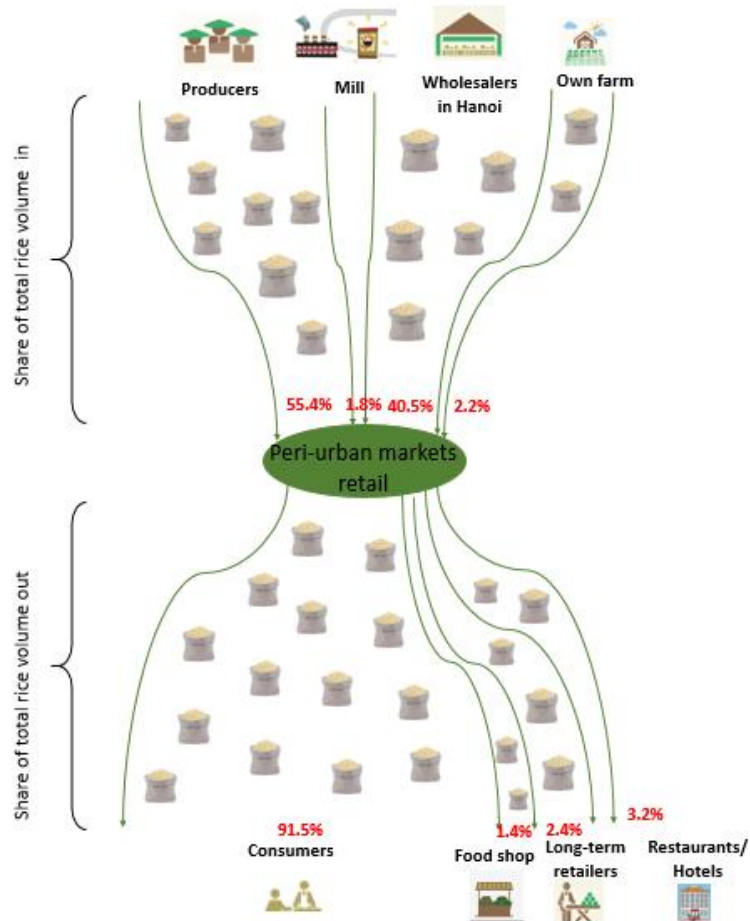


- Flows of rice in Hanoi traditional markets**

Flows of rice in traditional markets in Hanoi are illustrated in Figure 13. Wholesalers in Hanoi dominate the input flows of the retail markets while mills dominate the input flows of the wholesale markets.

**Figure 13. Flows of rice in Hanoi traditional markets**



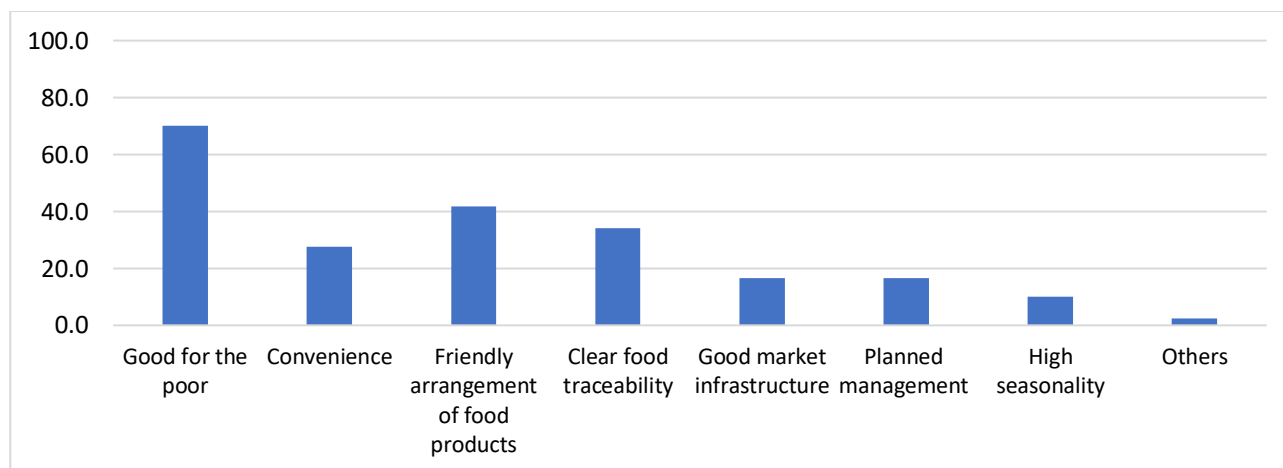




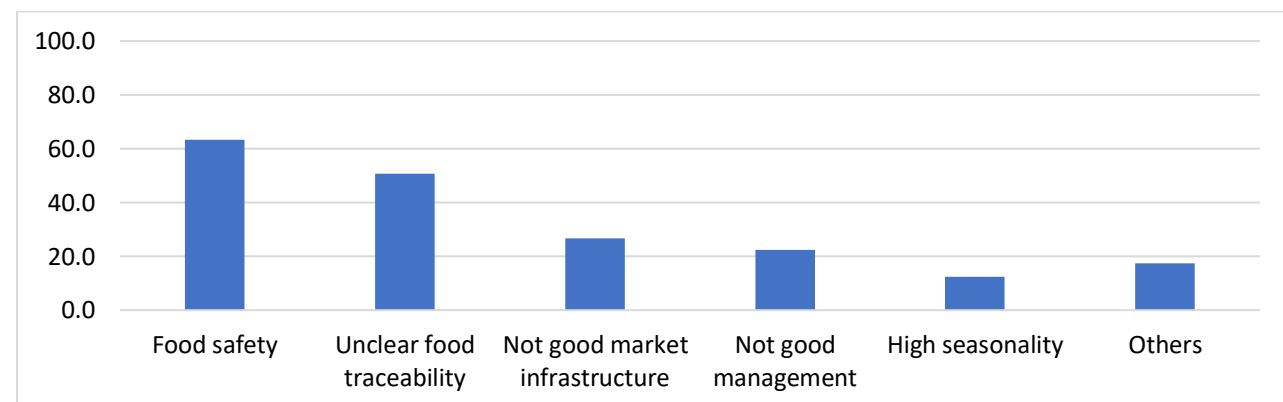
#### 4.4. Strengths and weakness of the food flows in Hanoi traditional markets

Traditional markets are most suitable for the poor and food products are easily accessible (Figure 14). Many sellers reported that most of their customers were low-income people and foods sold here were their first choice. However, food safety and untraceable products are of great concern for the food flows in Hanoi traditional markets (Figure 15). They are aligned with recent research on food systems in Vietnam in general (World Bank 2017, Raneri & Wertheim-Heck 2019, Tuyen *et. al.* 2020). As such there is a need to overcome weaknesses in order to make sure that traditional markets and retail channels deliver safe and nutritious foods to consumers, especially low-income ones.

**Figure 14. Strengths of the food flows of Hanoi traditional markets**



**Figure 15. Issues need to considered in the food flows of Hanoi traditional markets**



## 5. Discussions

Regarding vegetable distribution, the analysis reveals the largest share of vegetables from wholesale markets to retail markets in both urban and peri-urban areas (58% to 75%). This has been confirmed in previous research (Nguyen Thi Tan Loc, 2016; World Bank 2017). Food safety and unclear food traceability are two main issues mentioned by many vegetable retailers. Therefore, necessary priorities and solutions need to be proposed in terms of market management of Hanoi wholesale markets.

Vietnam has the highest rates of food loss and waste in the Asia-Pacific region according to a survey by Electrolux in 2016 (AsiaOne, 2016). It is estimated that fruits and vegetables generally account for 32% of food loss from farm to consumer (CEL Consulting, 2018). However, there is little research on food loss in traditional markets. Our study shows high rates of food loss for dark green leafy vegetables in retail and wholesale markets (3.7% to 10.8% in the retail markets and 6.2% for the wholesale market for morning glory; 3.1% to 6.2% and 1.7% for different types of mustards in retail

and wholesale markets, respectively). A 2019 study for Hanoi indicated the dark green leafy vegetable food loss occupies 3% of weekly volume at the retail level (Alliance's own data estimation, 2019<sup>7</sup>). Research on the supply chain of mosk pak choy (*Brassica parachinensis*) from Hung Yen to Hanoi in 2005 indicated that a seller in Hanoi traditional markets had to spend 14.3% of total costs for food loss per every 100kg which was equivalent to 14.3% of volume for loss (Lillian Diaz *et al.* 2005). Although the volume of food loss is quite high every day, as observed the infrastructure of traditional markets are currently inadequate for food loss management which leads to environmental issues in markets. The initial results on food loss for some specific vegetables in traditional markets in this study are expected to be important inputs to identify upgrading strategies for traditional markets, especially for wholesale markets, that can help contribute to reduced rates of food loss.

In terms of pork distribution, slaughterhouses are the main source for pork supply in Hanoi traditional markets. However lax management in terms of environment pollution and food safety has become an issue in slaughterhouses serving Hanoi in recent years. In 2019-2020 Hanoi had nearly 800 slaughterhouses of which 7 are industrial scaled units, 46 are semi-industrial-scaled units, and the rest (nearly 700 units) are traditional family-sized units. Notably in addition to industrial and semi-industrial units, only 168 family-sized slaughterhouses are licensed. According to the Hanoi Veterinary Department, the city is currently able to control and manage 60% of the total volume of pork while the remainder is supplied by family-sized slaughterhouses with little to no oversight. Family-sized slaughterhouses are not located in fixed places, and often operate randomly, making it difficult for inspection and monitoring of hygiene and food safety (DARD 2020). In addition, in traditional markets, although market system development has been taken into account by governmental policies, the market system, especially wholesale markets, have not been well planned. Some small businesses do not follow good manufacturing practice (e.g. unpacked product, using additives and preservatives) and most of the markets lack standards, adequate structure, and do not ensure food safety nor the full application of appropriate quality management systems (DOIT, 2019). This implies the need for better management system for pork in traditional markets.

As shown before, the project includes 3 different layers with the aim at providing answers on the structure of food flows in Hanoi traditional markets. This report only provides results and discussions on Layer 3 with efforts to illustrate the food flows. There is a need to improve upon results with additional data from Layer 1 and 2 and cross-check amongst layers as well as create a linkage between urban and peri-urban areas and between wholesale and retail markets in order for proper policy recommendations.

## **6. Limitations of the methodologies of Layer 3 and recommendations**

We were among the first to try a registration-form based collection method, where sellers recorded the data by themselves weekly with supervision from the market management board, to understand the traditional markets. This novel approach seeks to support the future development of apps to monitor food flows in markets. We realize that data are not always entered in the way most suitable for analysis. Data entry is time consuming (in this case for the market boards) and data cleaning takes quite some time as a result. In future iterations, we would consider combining these methods

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<sup>7</sup> Data belongs to the ongoing project of the Alliance named "Increasing fruit and vegetable intake of low-income populations in Vietnam and Nigeria through food system innovations".

through (bi)-weekly registration-forms and an annual or bi-annual full survey. Data from this latter method could then also be used to verify the data quality from the registration forms.

As we expect food flows to vary over time mainly because of changes in market-or product-type wide supply and demand. Thus in the future it might be considered to rather opt for cross-sectional surveys taken among a varying group of random sellers at different points in time. This might reduce the risk of sellers and others getting fed-up with the survey.

The panel-nature of this data has the advantage that data on quantities can be collected over time. However, it also means that the same vendor has to fill in the same lengthy form every week. Information like quantities or prices are sometimes quite sensitive to record, so there might be a decrease in the real value while reporting. The market board is a useful implementing partner, since it is one of the few institutions that actually has an idea of the volume and value of products flowing in and out of the market. The board is a party who encourages and clearly explains to recorders about how they would benefit from the survey. At the same time, this gives them an information advantage over us as a researcher, since we have no means of checking the values they enter beyond using mere logic.

A choice was made to implement this pilot survey on a relatively small scale, with a focus on wholesale markets. The limited sample size, however, makes it rather difficult to draw generalizable conclusions on the basis of this survey at this point in time. Results and findings in wholesale markets were validated by sellers and management boards via focus group discussions. For retail markets, the size occupied over 50% of the total sellers for each product, thus they were acceptable in terms of the representativeness.

## **7. Remarks**

The structure and centrality of food flows, distribution systems and actor networks are quite dependent on the product. Although producers, wholesalers and retailers play a role in each food chain, the respective importance of each of these actors is influenced by many factors beyond the scope of this portfolio. Generally, though, wholesalers are a key nodal player in three types of products.

The traditional markets investigated through our survey are only a part of the urban food supply chain. Much of the food is distributed through much smaller neighbourhood-street markets. Given that these markets are also largely supplied by wholesalers and the number of wholesale markets is relatively small, the food flows and transactions occurring in these nightly wholesale markets probably provides the best-possible estimate of total flows within a city. For peri-urban areas such investigations might be more complex, since there will be more actors in the supply chain taking up different roles. In these cases, the statistics from the more limited number of retail markets are more helpful. Finally, the increasing amounts of food acquired through modern food-supply channels like supermarkets should be taken into account. Although literature shows that for fresh food that quantities bought in such outlets are still relatively small, these channels are likely to play an increasingly important role in the future (Raneri & Wertheim-Heck 2019).

In line with previous research (eg. Raneri & Wertheim-Heck 2019), we learn from the survey that affordability and convenience of traditional markets are indicated as a core strength. In terms of issues, food safety, poor market infrastructure and unclear food traceability are often indicated. Seasonality is not something that seems to bother actors much, even consumers do not indicate

this as a prominent issue. Within the literature there are indications that government policies play an important role in the livelihoods of retailers. Our closed surveys only provide limited opportunity to delve deep into the real challenges many of these market actors face on a daily basis. Further exploration of this topic thereby constitutes another promising avenue of future research.

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