



In partnership with
Canada

REPORT

GENDER-BASED PORK VALUE CHAIN ASSESSEMENT IN HANOI



SAFEGRO
● ● ●

April 2023, Ha Noi, Viet Nam



IMPROVE LIFE.

**GENDER-BASED VALUE CHAIN ASSESSMENT
FOR
HANOI PORK VALUE CHAINS
April 2023**

Submitted to:

**Global Affairs Canada
(Formerly the Department of Foreign Affairs, Trade and Development)**

Submitted by:

ALINEA INTERNATIONAL
14707 Bannister Road S.E., Suite 200
Calgary, Alberta T2X 1Z2
Phone: (403) 253-5298
Facsimile: (403) 253-5140

UNIVERSITY OF GUELPH
The University of Guelph
50 Stone Road East
Guelph, Ontario
N1G 2W1



About the project

Funded by Global Affairs Canada, our project seeks to enhance the Vietnamese people (Ha Noi & Ho Chi Minh city) access to safe and competitive agri-food products, with an aim to improve the well-being of consumers as well as other agri-food actors. SAFEGRO project is implemented by Alinea International in partnership with the University of Guelph.

Food safety is a major public health concern. Many people do not trust food safety enforcement at informal markets where they buy most of their food. Trade for Vietnam's commodity exports also suffers due to a lack of compliance with international standards.

SAFEGRO project works with national and municipal governments to modernize food safety capacity among regulators, thousands of smallholder farmers, cooperatives, processors, retailers and consumers along specific meat and vegetables value chains in Ha Noi and Ho Chi Minh city. SAFEGRO supports Vietnam's Ministry of Agriculture and Rural Development, Ministry of Health and Ministry of Industry and Trade jointly.



Contents

Tables.....	2
Figures	2
ACRONYMS AND ABBREVIATIONS	3
EXECUTIVE SUMMARY	4
SOME BASIC TERMS.....	6
1 INTRODUCTION.....	7
2 OBJECTIVES.....	8
3 METHODOLOGY AND APPROACH	9
3.1 Approach	9
3.2 Value chain selection method.....	10
3.3 Information collection and processing methods	12
3.4 Data analysis.....	12
4 RESULTS.....	13
4.1 Present situation of pig production, slaughtering and pork value chains in Hanoi	13
4.2 Structure of surveyed pork value chain in Hanoi	15
4.3 Analysis and assessment of the pork value chain operation.....	16
4.4 Food safety management in the surveyed pork value chain of Hanoi	29
4.5 Gaps and Opportunities to enhance gender mainstreaming in pork value chains.	32
4.6 Environment and climate change	36
4.7 Traceability	37
5 CONCLUSIONS AND RECOMMENDATIONS.....	38
Reference.....	44



Tables

Table 1: Gender analysis in GBVCA.....	9
Table 2: Sample size and method of collecting information	11
Table 3: Basic inputs for pig production	16
Table 4: Production scale	18
Table 5: Production infrastructure per farms (average).....	19
Table 6: Surveyed production areas.....	22
Table 7: Basic characteristics of slaughtering, slicing, processing	23
Table 8: Expected steps of slaughtering process.....	31
Table 9: Frequent decision-makers for activities of the surveyed pork value chain.....	34
Table 10: Intervention proposal within the SAFEGRO framework.....	39

Figures

Figure 1: Gender integrating group discussion in Son Phu.....	11
Figure 2: Interview of a producer and slaughterhouse.	11
Figure 3: Diagram of pork value chain surveyed in Hanoi.	15
Figure 4: Distribution channel in pork chain of Son Phu.....	27
Figure 5: Distribution channel in pork chain of Dong Tam	27
Figure 6: Distribution channel in Hoang Long’s pork chain	28
Figure 7: Distribution channels in pork chain of Vinh Anh company.....	29
Figure 8: Participation of men and women in the pork value chain of Son Phu Cooperative	33

ACRONYMS AND ABBREVIATIONS

ATTP	Food safety
ATSH	Biosecurity
BĐKH	Climate change
CSA	Climate smart agriculture
CSGM	Slaughterhouse
GAP	Good agricultural practices
GBA	Gender-based analysis
GBVCA	Gender-based value chain assessment
HACCP	Hazard Analysis and Critical Control Point System
HTX	Cooperative
ILRI	International Livestock Research Institute
ISO	International Organization for Standardization
KD	Business
MARD	Ministry of Agriculture and Rural Development
NAFIQAD	National Agro-Forestry-Fisheries Quality Assurance Department
QĐ	Decision
SAFEGRO	Safe Food for Growth Project
SX	Production
TACN	Animal feed
TTY	Veterinary medicine



EXECUTIVE SUMMARY

The surveyed **pork value chain** in Hanoi has four main characteristics: input supply; pig raising; slaughtering, preliminary and deep processing; and distribution to retail and consumers. Chain actors include breeding farms and input suppliers, pig raising farmers, cooperatives and/or slaughtering enterprises, distributors, retailers, and consumers. Each actor can perform one or several functions of the chain. **The chain's products** include carcasses, meat cuts, and pork products such as sausages, bacon, etc. Products are supplied to commercial centers, supermarkets, convenience stores, collective kitchens, retail stores, online stores, and even direct-to-consumer. In particular, the cold chain distribution channel into commercial centers, supermarkets, convenience stores, and collective kitchens plays an increasingly important role.

The distributor plays the leading role in coordinating the whole chain. The **linkages** among chain actors are quite good. Cooperatives play the role of connecting pig-raising farmers and slaughtering houses. Currently, all chain members need more support due to the increasing competitiveness, higher investment level to meet food safety requirements compared to actors not participating in the chain model, and limited management capacity of householders and farmers. Cooperatives and householders have little experience with market development, and the pork market is still relatively unstable with price fluctuations and swine disease risks on the farms. Farmers recognize the impacts of climate change, especially hot/wet weather, on production and have been developing solutions to minimize negative environmental impacts but seem to be neglecting opportunities to save energy. Approximately 60% of the Hanoi pork supply is produced in licensed slaughterhouses under the oversight of the veterinary services.

Regarding food safety, pig-raising farmers and slaughterhouses have had access to technical support from previous projects on production processes. Some have been supported to achieve food safety certifications such as HACCP and ISO 22000; they have been introduced to connect to distributors and customers who can afford to pay the higher market price. However, some of the food safety certifications are based on self-declarations, and quality control systems and traceability still need to be improved. Son Phu Cooperative, for example, needs to improve the slaughter infrastructure.

Along the chain, **women** account for a higher proportion than **men** at most stages, especially those related to Food safety hazards. Therefore, increasing women's food safety knowledge is necessary, especially in processing, packaging, preservation, and retail. Women should be encouraged to participate in training on veterinary medicine and vaccination for pigs. Training should be arranged at an appropriate time and place so that women and men can participate as much as possible. The analysis of Son Phu Cooperative pork production chain shows that women's participation in decision-making in some production sectors has helped enhance their relationships with men and promoted gender equality in the production chain.

The SAFEGRO project proposes interventions related to **climate-smart agriculture (CSA)**: Selecting and establishing a smart livestock model, including implementing improved breeds and breeding practices, selecting suitable feed sources and pig-raising management and technologies to adapt to unusual and extreme fluctuations of weather; managing water sources, wastewater control in line with environmental standards; smart slaughterhouse design including cold storage, and waste treatment systems (waste

reduction, reuse of livestock waste for cultivation purposes); applying energy saving model; implementing effective traceability.

Based on the current pork value chain analysis, the research also proposes some interventions to promote a sustainable pork value chain toward higher standards, including general interventions and specific ones for specific groups of actors as outlined in Section 5.

Producers suggested that the Government should have a strategy to promote production models to ensure food safety, provide market forecasts, and real-time updates on market demand as well as regular prices so that they can proactively plan their production scale, avoiding the situation where the market is not balanced. They also propose to support traceability software, support for sample analysis costs to ensure that the farming process is always up to standard, support communication so that consumers know about safe production models and products, raise awareness on the consumption of safe products, support training, to improve management capacity, marketing, and sales capacity, to support output connections and sustainable linkages through fair, mutually beneficial contracts.

The relatively large-scale supply chain model of Vinh Anh company reflects many benefits for the actors in the chain, from producers, slaughterhouses, distributors, and consumers, in food safety and economic benefit, and creates favorable conditions for sustainable development for all the actors. However, the traceable linkages backward to the producers and forward consumer information is inadequate. The low slaughtering capacity (15-30% of physical capacity), and inefficiencies seems to originate with consumers preference for non-chilled, fresh meat. Communication should be enhanced to help people recognize the relative benefits of chilled meat consumption, especially from a food safety perspective. Emphasis should also be placed, as previously reported, on reducing and limiting small-scale slaughtering with bad food safety hygiene in residential areas. The establishment and development of the pork value chain should consider the distribution enterprises as the key actors, and cooperatives and cooperative groups as factors to connect farmers; with local authorities promoting the development of these chains. This includes the development of improved biosecurity, disease control, and reduction of veterinary costs. Standards, procedures, and guidelines on biosecurity in livestock production for farm-scale livestock and household production should be developed. Food safety could be considered as the core factor for sustainable development of livestock production with emphasis on compliance and enforcement of food safety management systems at all levels from farm (VietGAHP+) through training for processing, transportation (HACCP) and for food preparation and communication for pork handling at retail, in commercial kitchens and in the home.

SOME BASIC TERMS

Value chain: The value chain describes the full range of activities required to bring a product or service from conception, through the different phases of production, delivery to final consumers, and final disposal after use^{1,2}. In this case it includes all nodes for pork from on-farm production, through slaughter to retail and consumption.

Gender refers to the social attributes and opportunities associated with being male and female, the relationships between women and men, and girls and boys, and the relations between females and males. These attributes, opportunities, and relationships are socially constructed and learned through socialization³.

Gender-sensitive is the ability to perceive gender issues, especially recognizing differences in perceptions and preferences of women from different social positions and gender roles. Gender-sensitive is considered the beginning stage of gender awareness. Then there is more analysis, criticism, and questioning of gender disparities⁴.

Gender-based analysis, plus (GBA, Plus) is a tool to examine gender differences. Gender-sensitive analysis are needed to identify the different impacts of policies and programs on women and men. Gender analysis addresses economic and social disparities between men and women at all stages of the planning and implementation process and helps identify potential differential effects before they occur. The GBA challenges decision-makers to question the assumption that policies and programs affect everyone similarly⁵.

Climate-smart agriculture (CSA) is an approach to transform and reorient agricultural production systems and food value chains towards sustainable development and food security in the context of climate change (CC). CSA has three main objectives: i) increase productivity and income sustainably, ii) adapt and build resilience to climate change, and iii) reduce or eliminate greenhouse gas emissions. The CSA approach is seen as a starting point for essential information on making agriculture, forestry, and fisheries a part of the solution to reduce the negative impacts of climate change.

Biosecurity (ATSH) in livestock production includes technical and management measures to prevent and mitigate the introduction of infectious agents into a production facility and contamination of natural or human-induced biological organisms or hazards that harm humans, animals, and ecosystems.

Food safety: means the practices, processes, procedures and behaviours required to provide assurance that safe food does not cause harm to human health and life (Article 2, Law on Food Safety of Vietnam, 2010).

Food traceability refers to tracking down food creation and circulation (Article 2, Law on Food Safety of Vietnam, 2010).

¹ R. Kaplinsky, 'Toàn cầu hóa và sự bất bình đẳng: Có thể học được những gì từ Phân tích Chuỗi giá trị', *Tạp chí Nghiên cứu phát triển*, tập. 37, số. 2, 1999, trang. 117-146.

² R. Kaplinsky and M. Morris, *Cẩm nang Nghiên cứu Chuỗi giá trị*, Brighton, Viện nghiên cứu Phát triển - Vương quốc Anh, Đại học Sussex, 2001.

³ Gender and Social Inclusion Toolkit, Winrock International, page 2

⁴ Gender and Social Inclusion Toolkit, Winrock International, page 2

⁵ Gender Based Analysis Plus, Government of Canada

1 INTRODUCTION

Funded by Global Affairs Canada, the Safe Food for Growth (SAFEGRO) Project seeks to enhance the Vietnamese population's access to safe and competitive agri-food products, with an aim to improve the well-being of female and male consumers as well as other agri-food actors. SAFEGRO is implemented by Alinea International in partnership with the University of Guelph.

The gender-based pork value chain assessment is an activity under Component 2: “Strengthened capacity of poor farmers and other actors, particularly women, along the value chain to supply safe agri-food products, taking gender equality and environmental sustainability considerations into account”, and “provided to agri-food producers and processors, particularly women, to follow food safety regulations, procedures and good agricultural/ manufacturing practices that are environmental sustainability consideration into account”. The assessment is conducted in Hanoi, one of the key cities selected for the project, to assess the present situation of the value chain in various aspects: capacity of the actors; chain link; food safety risks and management; gaps and opportunities to enhance gender integration in the chain; environment and climate change; science and technology application and traceability. At the same time, the report also assesses the challenges faced by chain actors and potential opportunities. The report subsequently proposes a set of related project interventions to upgrade the chain to comply with accepted food safety best practices and improve added value for the whole chain aligned with international standards. This report also provides the foundation to formulate other related but unanticipated project activities.

The report is implemented under the cooperation between the SAFEGRO consultants and local staff, the Hanoi Inter-sectoral Working Group encompassing the three partner ministries (MARD/MOH/MOIT). This report has been reviewed by the SAFEGRO Inter-sectoral Working Group through a consultation workshop including key stakeholders and their recommendations have been incorporated.

2 OBJECTIVES

This research has two major objectives as follows:

- Assessment and selection of suitable pork chains aligned with SAFEGRO objectives and Hanoi government priorities, which will be used for future intervention.
- Recommendation of suitable interventions for improving the selected pork chain with a focus on food safety, gender issues, and strengthen chain actors' capacity, traceability, environmental sustainability, and CSA practices.

3 METHODOLOGY AND APPROACH

3.1 Approach

A value chain involves the participation of different actors in input supply, production, collection, processing, and distribution of products. Such a value chain has many distribution channels, each involving different actors, from input providers to end consumers. Pork value chains can be expansive encompassing a wide range of key actors or reflect a more vertically integrated enterprise from production to retail.

The safe agrifood supply chains have been established by provinces in accordance with Ministry of Agriculture and Rural Development (MARD) Decision No 3073/QĐ-BNN-QLCL dated 27/12/2013 approving the *Scheme to build and develop safe agricultural, forestry, and fishery food supply chain model nationwide*. These chains include the participation of primary producers, preliminary processing and processing actors, and product distribution; broadly encompassing the whole city, and, more narrowly, specific supermarkets, shops, and markets, of which the primary producers (e.g., cooperatives) or preliminary processing and processing actors are the driving actors of the chains⁶.

In this report, the value chain assessment considers participation of primary producers, preliminary processing and processing actors, and products distributors, and more broadly specific supermarkets, shops, markets. The primary producers (e.g., cooperatives) or preliminary processing and processing actors are the key driving actors of the chain.

The gender-based approach focuses on the social attributes of the stakeholders (gender-based value chain assessment- GBVCA) through which assessors will consider the difference and complementarity in the roles of men and women at every stage of the chain to determine if there are any gender gaps in the chain? With the current capacity of the stakeholders and institutions, are there any opportunities to fill in or narrow such gender gaps? Notably, gender issues should be paid attention to while applying GBVCA to the selection, analysis of, and intervention in the chain, as presented in Table 1.

Table 1: Gender analysis in GBVCA

Activity	Content
Select value chains	Select the value chain based on potential factors contributing to promoting gender equality and women's empowerment.
Analyze value chains	Select and survey the value chain with the participation of gender experts. The value chain implementation team is trained on gender and has gender knowledge and women empowerment. Analyze the role of gender, barriers, and gender gaps in the value chain. Analyze the opportunities to promote gender equality or contribute to women's empowerment. Analyze data based on the gender and social attributes of participants.
Improve, and upgrade	Organize training activities to enhance gender understanding and gender mainstreaming.

⁶ Hanoi DARD, Report on management of agricultural material quality, food safety of agricultural, forestry and fishery products in Hanoi in 2021

the value chains	Formulate a specific action plan to reduce gender gaps. Achieve specific results towards gender equality and women empowerment.
------------------	--

Source: Research team, 2023

In addition, the CSA approach applied to analyze the chain will consider how actors use climate change adaptation strategies and actions in the selected chains for their good agricultural practices (GAP), and how it affects food safety assurance in the value chain. Based on that, appropriate strategies to adapt to and minimize the impacts of climate change on pork production and consumption are proposed to ensure food safety, resilience and sustainability.

3.2 Value chain selection method

Based on the project objective, the agreement signed between the National Agro-Forestry-Fisheries Quality Assurance Department (NAFIQAD), Hanoi Department of Agriculture and Rural Development (DARD), and SAFEGRO on 15 August 2022, the SAFEGRO team cooperated with the Inter-sectoral Working Group, consulted with Hanoi Livestock Production and Animal Health Sub-Department, Hanoi Agro-Forestry-Fisheries Quality Assurance Sub-Department and International Livestock Research Institute (ILRI) and used following assessment criteria to select the pork value chain:

- Management of production and food safety.
- Infrastructure for production and business.
- Organization of product consumption.
- Traceability.
- Capacity to apply information technology.
- Gaps and opportunities for gender integration.
- CSA.
- Willingness to participate in the project activities.

To select the chain for the assessment, we started from the slaughterhouses because they are considered the bottleneck of the chains: Hanoi has 201 pork slaughterhouses while it has many pig-raising farms and households; and many distributors and consumers. From the slaughterhouses, we traced backward and tracked forward to determine the other chain actors, including farmers, traders, distributors, and consumers. According to Decision No. 3075/QĐ-BNN issued on 20/7/2016 by MARD, there are two types of chains in Vietnam: the food supply linkage chain among producers, slaughterhouses, preliminary processing, processing and distributors, and farm-to-fork, vertically integrated chains of which the enterprises, cooperatives, and households are the owners and manage the whole supply chain from primary production through processing, and distribution. The team, therefore, selected and investigated three pork chains in three different districts of Hanoi, including:

* Networked pork supply chain including many actors, from pig-raising farmers, slaughterhouses, distributors, and retailers to consumers:

- o Large scale in production (many farms, including many smallholder producers and small-scale farms) and slaughtering, with the leadership of the slaughtering company, namely Vinh Anh Food Technology Joint Stock Company (Ha Binh Phuong Industrial Zone, Thuong Tin district, Hanoi).
- o Small scale: including some households involved in the production, slaughtering, preliminary processing, processing, and distribution to the consumers. The typical characteristic of this chain

model is the household scale level. There is an integration of some chain functions including production, slaughtering, preliminary processing, and some simple processing and distribution stages in Son Phu Cooperative (Bac Phu commune, Soc Son district, Hanoi) and Dong Tam cooperative (Can Huu Commune, Quoc Oai district, Hanoi)

* Vertically integrated pork chain owned and managed by Hoang Long Cooperative (Chi Le village, Tan Uoc commune, Thanh Oai district, Hanoi) from primary production to preliminary processing, processing, and trading of products.

Table 2: Sample size and method of collecting information

Actors leading the chain	Pig producers (People)	Slaughterhouses (People)	Distributors, supermarkets/convenience stores, retail shops	Collective kitchens/catering companies
Hoang Long Cooperative	All (4)	All (3)	Aeon Mall Long Bien; Local butcher shops	School kitchens
Son Phu Cooperative	All internal chain members (3)	All (3)	Uncle Tom (Bác Tô) stores; Bologa distributors; Local butcher shops	School kitchens
Dong Tam cooperative	All internal chain members (5)	All (3)	Tam safe food stores; F Food stores; Local pork products store	
Vinh Anh Company	In Hanoi (2)	Representatives (2)	Vinh Anh and Organic Green	School kitchens
Information collection method	In-depth interview, group discussion, observation	In-depth interview, observation	In-depth observation	interview, In-depth interview, observation

Source: Survey results, 2023



Figure 1: Gender integrating group discussion in Son Phu



Figure 2: Interview of a producer and slaughterhouse.

3.3 Information collection and processing methods

Collection of secondary information: Secondary information included data collection related to the situation of pig production, slaughtering, pork distribution, pork value chain, food safety management, traceability, etc. collected from national and local government offices, departments, sub-department, and previous related reports and research.

Primary information collection: Primary information was collected through in-depth interviews, focus group discussions (FGD), and observations. The design of questionnaires for pig production, slaughtering, and distribution actors incorporated previous studies, particularly those of the International Livestock Research Institute (ILRI). The team also conducted direct interviews and consulted with leaders, livestock production and animal husbandry managers, food safety managers, and international experts, especially from ILRI on related issues in the pork chain. After collection, data were cleaned, disaggregated for statistical purposes, and processed for chain analysis and assessment.

3.4 Data analysis

Consolidated information and data were analyzed using the following methods:

- Descriptive statistical method: use of tables and diagrams to analyze and describe the characteristics and relationships between actors in the chain and stakeholders supporting the chain.
- Value chain analysis method: used to shape and map the chain, analyze the functions, roles, the links and coordination between the chain actors, from production to distribution to consumers. In addition, it is also used to analyze the role of the stakeholders in supporting and promoting the chain.

4 RESULTS

4.1 Present situation of pig production, slaughtering and pork value chains in Hanoi

4.1.1 Present situation of pig production

According to Hanoi Livestock Production and Animal Health Sub-Department (2023), the disease situation of livestock and poultry in Hanoi was relatively stable in 2022, without large-scale outbreaks. The number of specific herds and flocks follows:

- Pig herd: 1,522,193 heads, including 167,848 breeding pigs; 1,354,345 meat pigs, and piglets; the total volume of slaughtered pigs were 18,900 tons/month. The buffalo and cow herds included 166,857 heads, 83,281 breeding cattle (16,654 dairy cows), and 83,576 beef cattle; the volume of slaughtered cattle were 1,144 tons/month. The fresh milk production was 3,300 tons/month. The poultry herd included 42,444,197 birds with a live poultry volume of 14,200 tons/month.
- Number of livestock farms: 91 large-scale farms; 1,387 medium-scale farms; 5,037 small-scale farms; and 190,608 production households.

Animal production in the city limits, however, still accounts for a large proportion of production; the proportion of animals raised in residential areas now accounts for about 60% of the total herd, while large-scale farms outside residential areas account for about 40% of the whole herd.

4.1.2 Present situation of cattle and poultry slaughtering

Hanoi Livestock Production and Animal Health Sub-Department (2023) reported that recently Hanoi has 730 slaughterhouses, including 83 for cattle; 201 for pigs, 442 for poultry (1 for both pig and poultry); and 05 involved in the slaughtering of other animals. Of which:

- 11 industrial slaughterhouses, including 5 for pig in Thuong Tin, Thanh Oanh, Gia Lam, and Dan Phuong districts.
- 50 semi-industrial slaughterhouses: including 12 for pigs.
- 670 manual slaughterhouses: including 184 involved in pig slaughtering.

Of the 730 slaughterhouses mentioned above, only 105 have local authorities' permission to operate and are under the control of local veterinary agencies. There are 41 pig slaughterhouses that are granted slaughtering control codes. These slaughterhouses produce more than 400 tons of pork meat daily, satisfying 60% of the demand for meat consumption in Hanoi. The city's estimated demand for meat is about 900-1000 tons per day.

Currently, most industrial, semi-industrial, and centralized slaughterhouses operate at less than their design capacity. Some industrial slaughterhouses have invested in a modern slaughtering line but can only operate at 15-30% of its design capacity (for example, Vinh Anh - Thuong Tin); some slaughterhouses must temporarily close their slaughtering activities (Foodex - Dan Phuong) or turn to floor slaughtering (semi-industrial slaughtering) to maintain their operation (Minh Hien - Thanh Oai). Small and manual slaughterhouses still exist in large numbers; slaughtering operations are diverse and scattered in most residential areas of the districts and towns encompassed by Hanoi.

4.1.3 Present situation of pork value chain development in Hanoi

Hanoi has supported the development of 159 production and consumption linkages for safe agricultural products, of which 47 supply chains are involved in animal-origin food, including 18 pork supply chains (Hanoi Agro-Forestry-Fisheries Quality Assurance Sub-Department, 2023). Pork meat and products from these chains are strictly controlled and provided to supermarkets, convenience stores, and designated safe butcher shops in the city. The chains supply the Hanoi market with more than 60 tons of pork meat daily. Some pork chains led by enterprises are engaged in all stages, from breeding, animal feed production, production organization, slaughtering, and preliminary processing of products. Examples of the large-scale vertically integrated farm-to-fork chain is C.P Vietnam Livestock Joint Stock Company, and the small-scale chain is Hoang Long Cooperative. Some chains integrate farmers, slaughterhouses, preliminary processors, processors, and consumers and are led by slaughterhouses, including the pork chain of Vinh Anh Food Technology Joint Stock Company, Son Phu Cooperative.

In general, the chains have initially been established with main actors through contracts that specify the rights and responsibilities of the parties involved in the links; legal documents for the chains have been provided to the team (food safety certificate for slaughterhouses, preliminary processing actors, businesses; self-declaration for products of the chains); and the FBOs involved have developed their respective brands and brand identity.

However, systematic cooperation between enterprises and producers from production planning, agreement of production practices, and supply of inputs (feed, veterinary medicines...) have not been established. Developing effective linkages in a sustainable value chain needs significant investment and time. The number of formal linkages from production, slaughtering, preliminary processing, processing, and consumption of products needs to be improved. Expansion of pork value chains has been limited by Vietnamese consumption habits which is predominated by pork meat purchase from traditional markets. In addition, policies, effective enforcement and financial mechanisms for investment in safe pork production and slaughter are limiting factors; informal, verbal agreements still dominate linkages among slaughtering, preliminary processing, processing, and consumption of products.

4.1.4 Challenges for pork production

Currently, swine disease epidemics still occur in some provinces. Meanwhile, it is difficult for household producers to apply biosecurity and safety practices in production systems due to limited conditions, capacity, and capital investments. Small producers may be reluctant to re-populate their herds after an outbreak.

Pig production is gradually changing from smallholder production in residential areas to high-tech industrial production in farms. However, large-scale production farms face difficulties in building farms that meet the requirements for production conditions as prescribed in the animal production legislation; limited biosecurity investments; constrained by the requirements for waste treatment technology by the relevant environmental legislation compliance; need for support from local authorities.

Verification of available swine breeds is problematic and breeding farms may lack registration and information to verify supplied breeds. . Some breeding farms lack quality assurance and lack information

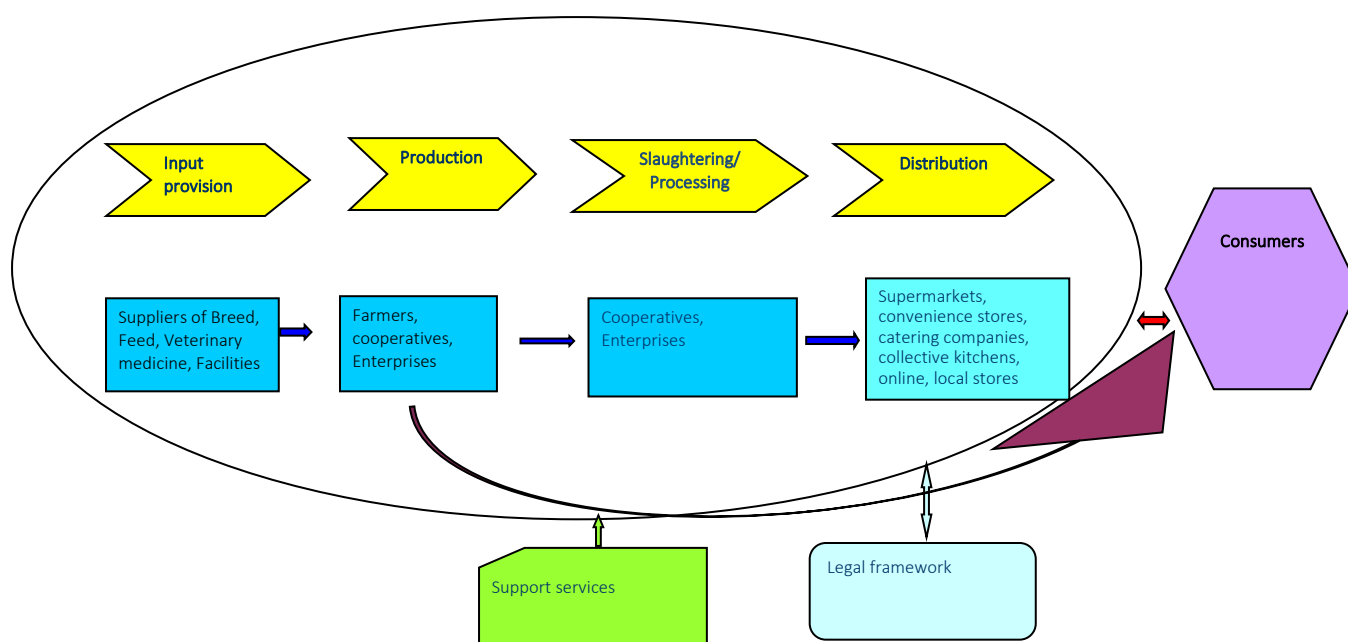
to confirm breed integrity. Scientific and technological advances have not been applied uniformly to the production of pig breeds, and quality breed products still need to be improved to meet the market demand. The production organization remains weak, lacks linkage, and is not proactive in seeking product consumption channels and market access. The production scale is still small and fragmented, and the application of industrial production processes in most household-scale, farms, and enterprises is limited. Food safety, hygiene assurance, and disease control need to improve, and the development of controlled and managed production chains with traceability still needs to be enhanced.

4.2 Structure of surveyed pork value chain in Hanoi

The surveyed pork value chain in Hanoi has four essential functions: input provision, production, slaughtering/preliminary processing/processing, and distribution to consumers, as shown in Figure 3. For each function, one actor or a group of actors is directly involved in creating added value for the chain. These actors are closely linked to form a value chain system with shared benefits and risks. The main actors participating in the pork value chain in Hanoi include producers/distributors of input materials for production (breeds, veterinary medicine, animal feed), pig-raising farmers (households, farms, or cooperatives); slaughterers, preliminary processors, processors; and distributors at informal markets and supermarkets, and safe pork shops.

At the surveyed pork chain, the roles of actors are integrated and a single actor may simultaneously perform 2, 3, and even all four chain functions. In the systems of Hoang Long and Son Phu, the cooperatives integrate the functions of input provision, pig raising, slaughtering, processing, and distribution of a part of its products. Meanwhile, in Vinh Anh's system, actors operate independently, contractually linked to share benefits and risks.

Figure 3: Diagram of pork value chain surveyed in Hanoi.



Source: Survey results, 2023

In addition, stakeholders are also involved in promoting the chain development in terms of legal framework and support services. The national to local governments create the enabling environment and issuing supportive policies, including ministries and relevant agencies such as MARD, Hanoi Department of Agriculture and Rural Development, Department of Industry and Trade, Hanoi Department of Science and Technology, Department of Livestock Production and Animal Health, Hanoi Livestock Development Center, Hanoi Rural Development Sub-Department, Hanoi Agro-Forestry-Fisheries Quality Assurance Sub-Department. Other technical support services for the value chain are provided by organizations focused on animal health issues, agricultural extension, slaughtering techniques, communication, information systems, banks, transport service units, associations (farmer unions,...), and others.

4.3 Analysis and assessment of the pork value chain operation

4.3.1 Inputs

Key inputs of the pork value chain include breeding pigs, animal feed, veterinary medicines, water for drinking and cleaning and assorted technical services.

Table 3: Basic inputs for pig production

Inputs	Son Phu Cooperative	Dong Tam Cooperative	Vinh Anh Company	Hoang Long Cooperative
Breed	From raising sows and buying from outside	From raising sows and buying from outside	From raising sows and buying from outside	Self-supply of breeding stock from the original breed of grandparents, parents Landrace, Duroc, Yorkshire, with clear origin
Animal feed	Self-mixed feed, as recommended by the main distributor	Self-mixed feed	Mainly industrial feed	Self-mixed feed, using the formula of the cooperative
Veterinary medicine, vaccines	Purchased from local veterinary medicine stores, no transparent record keeping	Purchased from local veterinary medicine stores, no transparent record keeping	Purchased from local veterinary medicine stores, the use process on the farms is relatively strict.	Purchased from local veterinary medicine stores, the use process on the farm is relatively strict.
Water source	Well water	Well water	Tap water/well water	Water is filtered three times, reducing pathogens, and controlling heavy metals.

Source: Survey data, 2023

Breeds

The pig raising households of Son Phu and Dong Tam Cooperative produce piglets themselves by raising sows or purchase from the Japfa company, providing a clear origin for the pigs raised by the households. Hoang Long Cooperative initially bought grandparent and parent breeding pigs, and then produced piglets through selection based on conformation, growth and health of their offspring, assuring origin of the

offspring. At the chain led by Vinh Anh Company, some pig farms/households produce their piglets by raising sows, while some other farms link with and buy piglets from breed supply companies or farms/households raising sows. When buying piglets, the standard selection criteria include certificates of good breed quality, morphology, origin, and cost. Producers also face risks in selecting piglets which may be sick or of questionable origin.

Animal feed

In terms of animal feed, pig raising farmers in Son Phu, Dong Tam and Hoang Long Cooperative mix their own feed, while households/farms in Vinh Anh Company's chain buy most feed commercially. The households of Son Phu Cooperative may supplement the diet with agricultural by-products, such as banana leaves and vegetables. They buy corn, barley, spent beer, worms, probiotics, and edible fungi and mixed these feeds based on the formula suggested by their suppliers such as Uncle Shrimp (Bác Tôm⁷) safe food stores. They also link up with two external farms producing about 500 pigs from which they purchase pigs for fattening. The supplying farms use the same feed mixing formula and production practices, highlighting the focus on feed quality. The team also noted the enterprises emphasis on product quality, and technical support (construction of barns, feed, waste treatment). But the farms' scope remains limited, in terms of available space and scalability, suggesting there may be an opportunity for expansion. The households of Dong Tam Cooperative buy corn, barley, spent beer, and probiotics to mix their feed, reflecting the commitment to quality but the farm is experiencing limitations in terms of their footprint and expansion.

Hoang Long Cooperative, similarly, uses the cooperative's formula to buy corn, wheat, oil, calcium, vitamins, EM yeast, herbals, to mix in the feed. but commercial feed is used for sows and piglets. In addition, the cooperative reported regularly testing water ad feed for heavy metal residues and antibiotics to control them in the production process, potentially reflecting attention to feed quality, water quality, and to ensure control of residues, antibiotics, and banned substances in the production process.

In the system for the Vinh Anh company, they provide feed distribution through agents to pig production farms and households, on a significant scale. They provide manufactured feed from CP, Green Feed, Austfeed, Nam Thanh and others. For large-scale farms, feed production companies technical staff visit farms to provide technical support, collect feedback from farmers and observe the effectiveness of the feed to optimize their products and strengthen their competitiveness in the market. These fee suppliers and distributors often sign contracts with feed manufacturing companies, while usually having only verbal agreements with the households/farms. The feed manufacturing companies often apply promotional programs to support these agents and farmers.

When mixing feed, households/farms rely on previous production experience, learn from other producers, consult with extension staff and cooperatives, refer to the guidance on television, newspapers, or local veterinary officials, and sometimes consult from feeding companies. Most households/farms try to feed commercial concentrate feeds according to the manufacturers recommendations but this may but this was

⁷ Uncle Shrimp clean food store system: [Uncle Shrimp - Clean food, Safe food \(bactom.com\)](http://bactom.com)

reported to be somewhat inaccurate and the ration is often just an approximation of the recommended quantity..

Veterinary medicine

Most households/farms buy veterinary medicine from their local veterinary medicine stores. Hoang Long Cooperative reported that the use of medication is strictly monitored, well applied, recorded, and reported daily via Zalo to the cooperative leaders. No records were available to be reviewed regarding use of medicines and related information for traceability.

Drinking water for pigs

Regarding the drinking water sources for pigs, some households/farms provide tap water and some use well water. In Hoang Long Cooperative, drinking water for pigs is filtered 3 times: coarse filtration with quartz sand, fine filtration with quartz sand and activated carbon, and filtered through an ionized water purifier. It was reported that filtered water is free of contaminants such as heavy metals (arsenic and lead), and safe from microbiological pathogens such as *E. coli*.

4.3.2 Production

Production scale

The medium-scale household model is found in the Son Phu Cooperative, while the large-scale farm model is represented by Hoang Long Cooperative. The farms and households in the chain led by Vinh Anh company are mostly large-scale. Son Phu Cooperative has the smallest scale of 500 heads per year, while the chain led by Vinh Anh company has the largest scale with Minh Ha company's farm of about 16,000 heads. The average rearing time per batch from farrowing to slaughtering is six months, with a common slaughter weight of 80-140 kg/head.

Table 4: Production scale

Type of pigs	Number (head)	Number of batches/years	Average time for a batch (month)	Slaughter weight (kg)
Sow	35.67	2.67	3.00	8 (piglet to sell)
Meat pig	683.33	2.00	6.00	124.17

Source: Survey data, 2023

Production infrastructure

The livestock producers have pigsty systems, walls, water pumps, heating lights, electric bulbs, water taps, feeders, net systems (to protect from insects), and cooling fans. In addition, farms/households have food storage areas and backup generators. This shows that farms and households have invested in and focused on good production conditions.

Table 5: Production infrastructure per farms (average)

	Number (piece)	Average cost (1,000 VND)	Average lifetime (year)
Water pump	2	36000	3
Heating light/halogen	64	2000	0
Electric bulb	28		
Drinking water tap	80.2	3500	12
Feeder	69.2	70000	13
Feed mixer	1	220000	13
Net	703.2	38500	2
Fan	26.4	31200	4

Source: Survey data, 2023

Production method and model

In Son Phu and Dong Tam Cooperative, production follows more traditional methods, whereas the Hoang Long Cooperative is vertically integrated and the Vinh Anh Company combines automatic and semi-industrial systems in the chain.

Production households in Son Phu choose an appropriate system based on their calculations to achieve the optimal scale, minimize costs, maximize profit, manage waste, and mitigate environmental impacts. The pigs are raised in a spacious and ventilated environment with space for pigs to interact and have begun to provide background music in the facilities reflecting an awareness of animal welfare, oriented towards natural activities, living in harmony with nature, and treating animals humanely. The households also treat animal waste and have built biogas treatment systems on a large space with a wastewater treatment pool. Producers reported the impacts of climate change, especially extreme heat that affects their animals and production efficiency. They use microbial padding to reduce food losses for animals and end of the transmission of smell from waster into the environment. However, this activity has just started, is still being tested, and needs an assessment. In addition, specific evidence of energy-saving activities has yet to be adopted.

During production, the households often contact and request assistance from the local veterinary staff which supervise the households' activities. The households try hard to update knowledge, strengthen exchanges in relevant associations (farmer unions...), and share knowledge and experiences in their networks. However, farm biosecurity appears to be lacking with limited access control, including expected disinfection procedures. In addition, the households also raise other animals (dogs, chickens) near the pigsties with limited pest control to prevent access by rodents and insects Recordkeeping to support traceability is inadequate and needs to improve.

Production households in Dong Tam choose an appropriate small-scale based on their calculations to achieve the optimal scale. The pigs are raised in a spacious and ventilated environment. The households have also treated animal waste and built biogas treatment systems. They have a large space with a wastewater treatment pool. They have seen the impacts of climate change, especially extreme heat that

affects their animals and their production effectiveness. However, there was no clear evidence of energy-saving activities on the farms.

In Hoang Long, the cooperative's farm is planned, designed, constructed, and arranged systematically in a large area. Commercial meat pigs are raised on the farm in a closed model, by the regulated process, and are VietGAHP certified, with a large scale of about 4000 pigs/year. The cooperative employs regular workers to raise pigs. The farm has a clear production process and an excellent prior-entry disinfection process. The farm also has a waste treatment system with regulating pools to minimize environmental impact. However, no specific evidence of energy-saving activities in the cooperative is seen. The farm has staff responsible for pig health and reproductive issues during production. This staff has not been adequately trained in animal husbandry or veterinary medicine, so their practice is mainly based on experience. The cooperative leaders work hard to update knowledge and strengthen exchanges with agencies and organizations to learn and share knowledge and experience. Although most leaders are quite old, they always make a great effort to adopt new technologies in the development process. However, the record for traceability has not been entirely and effectively kept.

In Vinh Anh, there are householders, small-, medium- and large-scale farms, and their pigs are fed with feed purchased outside. This production method is relatively convenient but more costly. Large farms have invested in semi-automatic feeding systems to minimize and save labor costs. However, large-scale production often requires a significant investment, large land, and its waste treatment is more complicated than smallholder production.

Pig production farms and households often have long relationships with feed suppliers and slaughterhouses. Some of them have tight linkages in written contracts. Currently, the production system in the chain of Vinh Anh company includes four main groups. The first group is the Minh Ha Company, with a farm of about 16,000 pigs. The second group is a system of farms and households linking to buy feed from and sell pigs to Nam Thanh Production and Trading Co. Ltd. This company has developed an Organic Green product chain model. In this model, pigs from farms and households that buy feed from Nam Thanh Company, following feeding recommendations and procedures, will be collected by this company at market prices (refer to CP's price). The third group is the pig farms applying CP standards. The fourth group is the farms linked to buying feed from New Hope Co. Ltd., and some other farms (e.g., Hoang Long Cooperative). The farms and households that buy feed from Nam Thanh Company have conducted traceability, but the traceability is being implemented semi-manually and needs to be completed. The enterprise leading the chain (Vinh Anh) has implemented traceability for the farms in the system but has yet to succeed.

All the households/farms feed the pigs in separate age groups based on their size and rations, and, in some cases, combined with music. Producers remove leftovers after each meal.

Production farms and households applied ten days' isolation before raising a new herd. The herd transfer and separation also result in stress that slows down the growth of pigs.

In production, households usually share experiences and learn from each other in mixing feed, caring for pigs, treating sick pigs, and treating the environment. They often exchange information via phone, social networks, and face-to-face meetings.

Most farms/households clean the pigsties daily, some clean the farms every few days. Most farms/households apply dry cleaning; some apply wet cleaning and use detergents bought from their local store. The pig-raising farmers also disinfect the pigsties every week. In case of high disease risk, disinfectant is sprayed more frequently, possibly every 2-3 days.

To minimize diseases in pigs, farms/households also regularly disinfect, clean feeding places and pigsties, shield and create a well-ventilated space for the pigsties. Production households of Son Phu Cooperative are testing microbial padding. For Hoang Long Cooperative, the whole farm is disinfected with lime, limiting people from entering, and requires careful disinfection before entering the pigsties. Most of the interviewed farms/households had experienced epidemic incidents. However, thanks to the timely prevention, detection, treatment, isolation, and good hygiene, the incidents had not greatly impacted their operation and production efficiency.

During production, the cooperatives take water and feed samples from pig-raising farms/households for testing as regulated every six months or when high-risk factors are seen to control food safety, test heavy metal content, or meet customer needs. This shows that the cooperative has paid attention to the quality of feed, controlled the water well, ensured no residues of antibiotics, and banned substances in the production process.

As most farms/households ensure food safety and hygiene by VietGAHP or their distributors' technical standards, the pig prices of the surveyed households/farms tend to be higher, from VND 1000 to VND 10,000 per kilogram of live pigs, than the market price. The production farms/households can get a 25% profit (excluding family labor) at this price.

Because the surveyed farms/households are involved in linkage chain from the production to consumption, most of the sold pigs can be traced with clear origin up to slaughter. When being sold, pigs are usually stamped with a quarantine seal by local veterinary staff. Producers also understand customer requirements such as food safety assurance, good-looking shape, clear certification, safe pigs, and no antibiotic and heavy metal residues.

Producers also adapt quite well to the changes and risks in the production process. They always have a strong spirit in disease prevention, always looking for ways to improve disease prevention techniques for pigs through such measures as strengthening pig resistance, cleaning pigsties, preventing sources of infection, and conducting disinfection... They understand the disease transmission routes and epidemics in pigs and limit the sources of infection. When an epidemic occurs in the local areas or in the herd, they will report it to the local authorities, ask for support from the veterinary staff to treat the diseases rather than selling off the pigs to local traders.

Table 6: Surveyed production areas

Criteria	Son Phu Cooperative	Dong Tam Cooperative	Vinh Anh Company	Hoang Long Cooperative
Operation	Raise sows for piglets and buy from outside, raise meat pigs, fattening pigs, and link with two external farms.	Raise sows for piglets and buy from outside	Link with farms and control well food safety from households/farms to slaughter	Control production quality from piglet stage to fattening, comply with antibiotic and banned substance residues regulations
Production models	Households participate in cooperative	Households participate in cooperative	Farm/Household	Have a large farm model of the cooperative
Environmental treatment	Change from wet production to dry production with padding	Wet production	Have an environmental treatment system	Treat waste well. Have a wastewater treatment lake.

Source: Survey data, 2023

Difficulties and challenges

According to the feedback of the pig-raising farms/households, the epidemic situation is one of the greatest difficulties and challenges for pig production. There is a disease risk everywhere, while some diseases have no vaccines or specific treatments, such as African Swine Fever (ASF). In addition, the pigs raised under food safety standards with higher costs and longer time are sold at almost the same price or just slightly higher than those raised without food safety standards. If the selling price is higher than the market price, consumption will face difficulties because many consumers have not chosen food safety products with higher price. The pig producers/farms applying food safety standards also complaint that they are still inspected and fined by the authorities while the common pig raising farmers are not. This reduces their motivation to participate in the pork supply chains and adopt food safety standards. In addition, they also face difficulties in finding suitable and quality raw materials for making feed, finding funds for investment, and re-investment. The fluctuating market is another challenge as raw material prices are increasing while output prices have tended to decrease in recent years.

The expectation of pig producers

Producers suggested that the Government should have a strategy to promote production models to ensure food safety, provide market forecasts, and update the amount of output to be supplied to the market as well as regular prices so that they can proactively plan their production scale, avoiding the situation where the market is not balanced. They also propose to support traceability software, support sample analysis costs to ensure that the farming process is always up to standard, support communication so that consumers know about safe production models and products, raise awareness on the consumption of safe products, support training, to improve management capacity, marketing, and sales capacity, to support output connections and sustainable linkages through economic contract.

4.3.3 Slaughtering, slicing, processing.

Basic characteristics of the slaughtering model, operation, capacity, slicing and processing of the surveyed actors are presented in Table 7.

Table 7: Basic characteristics of slaughtering, slicing, processing

Criteria	Son Phu Cooperative	Dong Tam Cooperative	Vinh Anh Company	Hoang Long Cooperative
Operation	Producers and slaughterers in the same system	Producers and slaughterers in the same system	Link production and slaughtering	Farm-to-folk chain model, both production and slaughtering in the same cooperative
Source of pigs for slaughtering	In farm and buy from linkage farms	Slaughter only pigs from the cooperative	From companies/farms/households: Minh Ha Company (16,000 pigs); associated farms of Organic Green; farms of New Hope company, CP and some other farms (e.g., Hoang Long)	Slaughter only pigs from the cooperative
Traceability	Not known	Not known	Traceability has been implemented but not successful	Static traceability has been implemented but not adequate
Slaughtering method	Manual	Small scale industrial method	Large scale industrial method	Small scale industrial method
Slaughtering scale	Slaughter 3-5 pigs a day. Although electric stunning is available, it is not fully implemented	Slaughter 3-5 pigs a day.	Slaughter about 100 pigs a day, using an industrial chain.	Small-scale industrial chain (Capacity 50 pigs/shift); hanged slaughtering, safer and more systematic closed line, current slaughtering capacity 5-10 pigs /day
Slicing	Have a small-scale semi-automatic slicing and packaging system	Have a small-scale semi-automatic slicing and packaging system	Have an industrial scale slicing and packaging system.	Have a small-scale automatic slicing and packaging system
Product	Carcasses, sliced meat, packed meat, and pork products (simple processed)	Carcasses, sliced meat, packed meat, and pork products (simple processed)	Carcasses, sliced meat, packed meat, and pork products (deeply processed products), including ham,	Carcasses, sliced meat, packed meat, and traditional pork products (simple processed)

	products) including ham, sausages.	products) including ham, sausages.	sausage, bacon, cartilage sausage...	processed) including ham, sausages...
Certificate	No certificate yet	No certificate yet	HACCP/ISO 22.000	Have VietGAP and HACCP certificates

Source: Survey data, 2023

In Son Phu, pigs are moved from farms nearby to the waiting area for slaughtering. The cooperative has a slaughterhouse with a system of pigs' electric stunning and hanging upside down to ensure food safety. The average slaughterhouse capacity is 3-5 pigs per day, accounting for 15% of the maximum capacity (30 pigs per day). The system of stainless-steel tables for slicing is quite clean, and the slicing tools and equipment are carefully cleaned. Slaughterers receive preliminary training, mainly based on practical experience. The cooperative also has vacuum packing and sealing machines. However, as this facility upgraded from the previous poultry slaughterhouse, the layout is not suitable for slaughtering pigs. The slaughterhouse is old, the space is very narrow, and the toilet is close to the slaughter place. The door and wall have open spaces that are easily penetrated by rats, bugs, and insects. This can lead to Food safety hazards.

Dong Tam Cooperative has a slaughterhouse with a system of pigs' electric stunning and hanging upside down to ensure food safety. The average slaughterhouse capacity is 3-5 pigs per day, accounting for 15% of the maximum capacity (30 pigs per day). The system of stainless-steel tables for slicing is quite clean, and the slicing tools and equipment are carefully cleaned. Slaughterers receive preliminary training, mainly based on practical experience. The cooperative also has vacuum packing and sealing machines. Their products include meat cuts, packages, and simple pork products.

Hoang Long Cooperative has focused on product quality management and has one person in charge. Pigs ready for slaughtering will be moved to the barn waiting for slaughter following a one-way process. The pig slaughterhouse is independent, far from residential areas, surrounded by closed walls, and separate from the outside. The cooperative has an area where pigs are kept in a pigsty, waiting for slaughter. The slaughterhouse has an area of stunning, bleeding, and dehairing. Pig dehairing is conducted with specialized equipment, with a closed lid during operation, helping dirty water not splash around when in use. The cooperative has a semi-industrial hanging slaughter line following a closed, regulated, safe, small-scale process with a maximum capacity of about 50 pigs/shift. However, the current capacity is only 6-10 pigs/day due to the limited consumption market. The organ handling area is in the slaughter area. The cooperative equipped a negative ion air purify lighting system and has a slaughter control officer from the Hanoi Animal Health/Veterinary Division to supervise the slaughtering process. Directors of cooperatives are trained in knowledge and good practice of food safety. However, the cooperative has not equipped a boot bath and use disinfectant. Slaughterers practice their work mainly by experience, with training but not at a proficiency level.

Based on the needs of customers, the cooperative decides the number of healthy, full-weight commercial pigs (95-115 kg) to move to the waiting area. The slaughterers observe the pigs and only slaughter when no signs of disease are detected. The water contained in the basin is used to wash and clean the temporary pigsty area, the dehairing machine, the pigs after dehairing, the semi-finished products after the organ

removal, and the floor cleaning. This may result in contamination/cross-contamination of pathogenic microorganisms into the semi-finished product. After the removal of organs, only water washing is performed. This may not have eliminated pathogenic microorganisms from the carcass surface after organ dissection. Besides, the organ handling area is near the meat slicing table. This may cause cross-contamination of the semi-finished product. Workers do many stages in the slaughter process, only washing their hands with normal water. This may result in contamination/cross-contamination of pathogenic microorganisms into the semi-finished product.

The pork slicing place of Hoang Long Cooperative has a room for slicing/chopping, packing and labeling products. The slicing table is made of 304 stainless steels. The cutting tool includes a cutting board, knife, tray containing semi-finished products and full products. After slicing, the meat will be packaged by a vacuum packaging machine, labeled, and stamped with the production date on the product label. The cooperative has a warehouse for packaging materials and product tools, and a processing warehouse (crushing, making sausages) equipped with a negative ion air purifying lighting system to disinfect and deodorize. In addition, the facility is also equipped with cool storage for semi-finished products (0-5°C), and cool storage for finished products (0-5°C). The entrance to the slaughterhouse is equipped with plastic nets to minimize the risk to food safety from insects outside.

The process of receiving, slicing, and packing is carried out on the principle of one-way; semi-finished products are transferred from cool storage, which reaches the temperature of 0-4°C, and meat is chopped according to specifications, packed, labeled, and preserved product. Semi-finished products are placed in stainless steel trays, using white cloth lining for the semi-finished products. However, the lining cloth shows signs of staining or occasional small black mold spots. Using unhygienic lining can cause contamination, and cross-contamination of pathogenic microorganisms into semi-finished products/finished products.

Hoang Long Cooperative applies and is certified with a food safety management system following ISO 22000. But the research team has not found concrete evidence of a plan to ensure food safety (for example, PRP, OPRP program). This may affect the effectiveness and efficiency of the ISO 22000 system.

The cooperative has a production record form tracking various products sliced from commercial pigs. However, the recording of meat processing in the clean room has not been fully done, and the identification number of slaughtered pigs has not been recorded. This affects the accuracy, authenticity, and effectiveness of the ISO 22000/product traceability system. Besides, the cooperative has not used the changing room for visitors (*change the PPE clothing outside before entering the clean room*). This may cause contamination and cross-contamination of semi-finished/finished products. In addition, currently, there is no boot bath to dip boots, and no protective boots for workers (wearing plastic sandals). This may cause contamination and cross-contamination of semi-finished/finished products.

At Vinh Anh company, the pig collection team will buy pigs from linking farms and transport them by truck to the barn waiting for slaughtering. If pigs are collected from outside the province, they undergo a full quarantine process. Therefore, the food safety management for commercial pigs entering the slaughter process is controlled. Vinh Anh Food Technology JSC does slaughtering. The pig slaughtering area is planned and built following European standards, away from residential areas, surrounded by closed walls, separate from the outside. The facility layout concerning European standards with all areas, including stunning,

bleeding, dehairing, industrial hanging slaughter line system, organ processing area follows a closed process to ensure food safety, with maximum capacity of 600 pigs/shift. However, the capacity is currently only about 80-100 pigs/day due to the limited market for cool meat consumption. Among Vinh Anh's customers, Organic Green is one of the big and regular ones. Organic green daily supplies and consumes around 1/5 of the pigs slaughtered at Vinh Anh's slaughterhouse.

The slicing area has room for slicing, packing, and labeling products. The slicing table and tools and equipment for slicing are well-invested and sufficient. After slicing, the meat will be packaged by a vacuum packaging machine and labeled and stamped with the production date on the product label.

Meat after slaughter is divided into 2 groups: Cool and cold. The facility has cool storage (0-5°C), and cold storage (-27°C đến -40°C) to preserve semi-finished and finished products. The cold storage system is professionally designed, and imported from Germany, with a capacity of 500 tons. Vinh Anh is considered one of the best synchronizing factories in the slaughter line, from electrostimulation to stunning of pigs to meat cooling in the North of Vietnam. The slaughter applies and is certified with a food safety management system following ISO 22000, has a production shift record form, and has tracking of products sliced from commercial pigs.

The chain's products include carcasses meat, half-carcasses meat, sliced, packaged meat, and processed products such as ham, sausages, bacon... This is considered and appreciated with good quality and can access the modern and local market (for festivals and gathering events...).

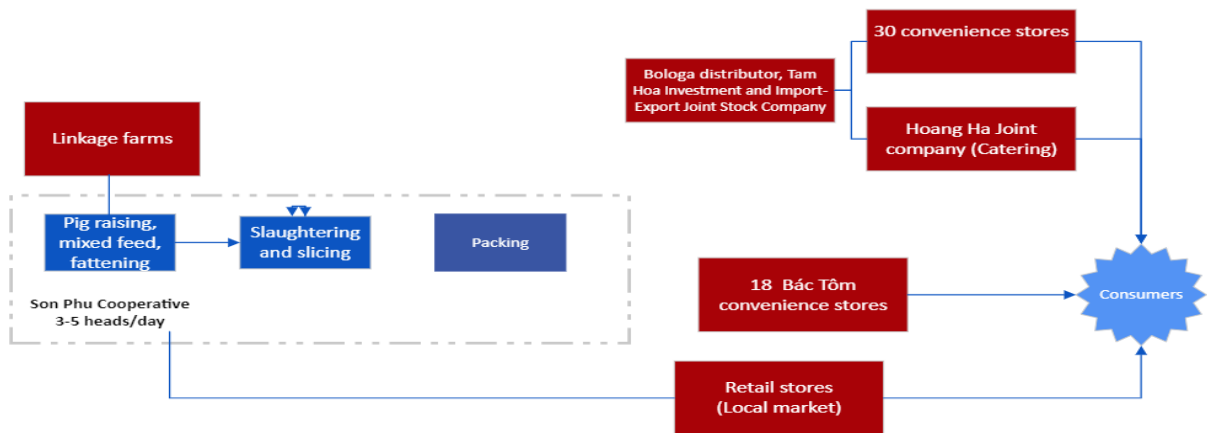
4.3.4 Distribution

Almost products of the chain are supplied to shopping centers, supermarkets, convenience stores, collective kitchens/catering companies; only small proportion to retail wet market, stores, online stores and directly to consumers. In particular, the distribution channel of cool meat (cold chain) to shopping centers, supermarkets, convenience stores and collective kitchens/catering companies plays an increasingly important role with a quite large proportion. However, there are slight differences in the physical flows of the chain.

In Son Phu, the distribution is mainly conducted by the system of Uncle Shrimp safe food stores (30%), Bologna distribution system (30%), some convenience stores (30%) and other local retail stores (10%). The cooperative has a close link in the written contract following a win-win model with the Uncle Shrimp store system and is provided technical advice from the Uncle Shrimp system on pigsties, feed mixing, production, shared information on the epidemic situation and provided financial support when needed. In addition, the cooperative signed a written contract with Tam Hoa Investment and Import-Export Joint Stock Company to distribute its fresh pork products. This company has developed the Bologna trademark, distributed meat of the cooperative to Hoang Ha Joint Stock Company – a catering company, specialized in providing industrial meals; and supplied meat to about 30 convenience stores within Hanoi city. In addition, the cooperative also has preliminary tools and facilities, and a cold chain truck. However, in some cases, products are still transported by common vehicles, especially to local retail stores.

Fresh meat products supplied to Uncle Shrimp and Bologa stores are mainly the products with high demand such as ribs, lean shoulder meat and belly pork. In addition to fresh meat products, the cooperative has also started to focus on processing some simple products, such as sausage, and ham, ... to utilize all the remaining meat, such as butt meat and tenderloin, ... However, there remain potential Food safety hazards in the product processing area when it is quite close to the toilet, which is under the relevant standard; the hand washing area is not scientifically designed and does not meet food safety requirements.

Figure 4: Distribution channel in pork chain of Son Phu

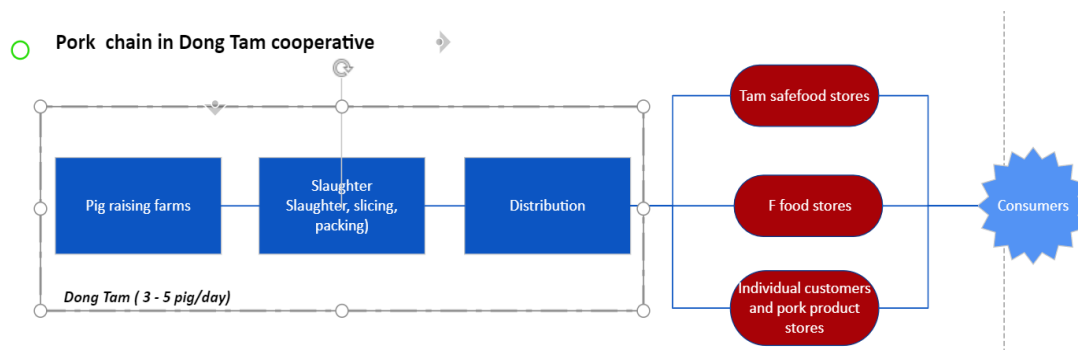


Source: Survey results, 2023

Dong Tam pork meat and products was distributed to Tam safe food and F food convenience stores, sold directly to the final consumers and the last was provided to pork products. The cooperative also has preliminary tools and facilities, and a cold chain truck. However, in some cases, products are still transported by common vehicles, especially to local pork products.

Fresh meat products supplied to convenience stores are mainly the products in high demand such as ribs, lean shoulder meat and belly pork. The cooperative has also started to pay attention to hiring local people to process some simple products: sausage, ham, ... to utilize all the remaining meat such as butt meat and tenderloin, etc.

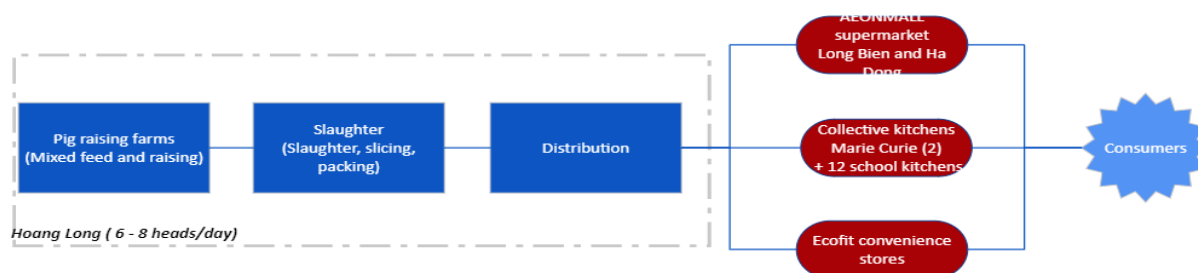
Figure 5: Distribution channel in pork chain of Dong Tam



Source: Survey results, 2023

Products of Hoang Long Cooperative are supplied to Ha Dong Aeon mall, Long Bien Aeon mall, Mega Market (50%); industrial kitchens, collective kitchens/catering companies of schools and businesses (30%); food retail stores (20%). The cooperative has cold chain storage facilities and transportation. The products are sliced, packed, and labeled. The labeling content complies with Decree 43/2017/ND-CP (product name, product photo, business name and address, contact phone; storage instructions). The products supplied to Ha Dong Aeon mall and Long Bien Aeon mall have also particular labels of these malls. However, not many products have labels. The labels do not have a QR code or barcode for product traceability, the database is not enough to trace backward and forward at the slaughtering and production stages as the information about the pigs slaughtered is not updated; the tracking information from the semi-finished products to finished products is not adequate at the slicing and packing stages.

Figure 6: Distribution channel in Hoang Long's pork chain

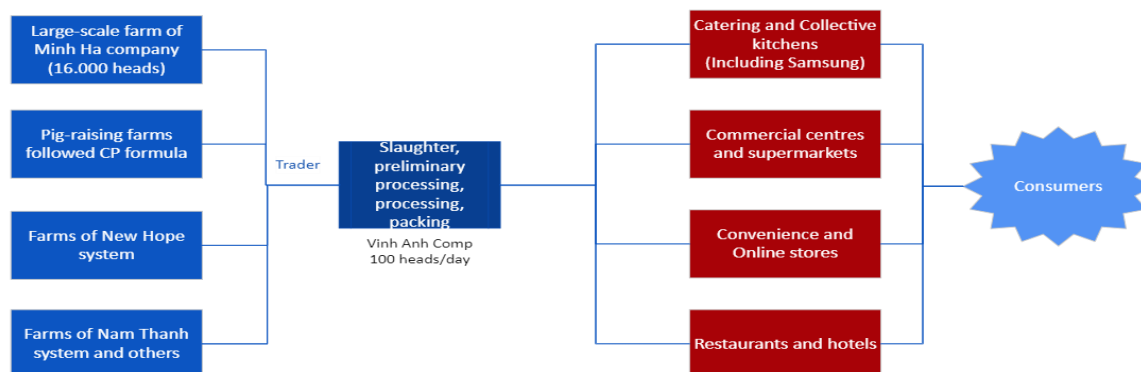


Source: Survey data, 2023

Vinh Anh's products are supplied to supermarkets BigC Hanoi, Metro Hanoi and Hai Phong, Oceanmart, Unimart, Coopmart, Fivimart as well as food processing factories and industrial kitchens, including Samsung company. Moreover, the company also has an online sales website (Vinh Anh Food Technology Joint Stock Company. vaf.com.vn).

In addition to Vinh Anh's products, products with Organic green trademark of Nam Thanh company are also preliminarily processed and processed at the same location. Organic green's products are distributed directly to consumers through a retail sale team, with promotion and direct communication programs through women's unions and trade union system.

Figure 7: Distribution channels in pork chain of Vinh Anh company



Source: Survey data, 2023

4.4 Food safety management in the surveyed pork value chain of Hanoi

Food safety hazards in the pork value chain can come from a variety of sources, classified into chemical hazards, biological hazards and physical hazards. In which, chemical and biological hazards are a significant group of hazards in the process of producing, slaughtering, processing and distributing pork meat.

Chemical hazards: Residues of antibiotics and growth promoters are possible chemical hazards in pork: commonly used antibiotics are Amoxicillin, Tyrosin, Tetracycline, Lincomycin, Gentamycin, Enrofloxacin, Neomycin with 3 purposes: to gain weight, prevent and cure diseases^{8 9}. In addition, an antibiotic in the banned list, chloraphenicol, still appears on the market under trade names such as Doc and Son. Growth stimulators, substances that produce banned substances such as Salbutamol, Clenbuterol, Ractopamine, Cysteamine are sold as probiotics, deworming for pigs. Furthermore, chemical hazards can come from mycotoxins that can be generated during the storage of animal feed or raw materials.

Microbiological hazards: Pork can be contaminated with pathogens (bacteria, fungus, virus) at any stage in the pork supply chain. Important biological hazards are Salmonella, E. coli. Besides food safety issues, biosecurity is a major concern of the livestock industry. Pigs are susceptible to pasteurellosis caused by *pasteurella multocida*, Leptospirosis, Edema caused by E coli, or parasites such as trichocephalus, Enterobiasis, Fasciola, etc., because of polluted environments.

Physical hazards: Pork meat can be contaminated by physical hazards due to cross-contamination during transportation, in the process of wholesale and retail. Physical hazards can cause injury to the consumer such as metal or glass contamination, or may not be harmful but are indicative of unsanitary handling such as hairs on meat.

⁸ Viện Chăn nuôi (Bộ NN&PTNT) thực hiện từ tháng 10/2018 đến tháng 3/2019 tại Hà Nội

⁹ Vi Thị Thanh Thủy (2012)

Results of the food safety hazards survey on the selected pork supply chain

Pig raising farm.

Food safety hazards may appear in the pig production process. The frequency and extent of contamination depends on many factors: facility conditions, barn hygiene, animal feed sources, process and dosage of drugs used to treat diseases and waste treatment.

- (1) *Quality of animal feed:* The pig farm of Hoang Long cooperative began to experiment with biological production, using fermented feed according to the technology of the Vietnam National Agriculture University, then self-adjusted and supplemented with herbs to obtain pork meat with high quality. The feed for commercial pigs of households in Son Phu is also self-mixed according to the cooperative formular. Industrial feed is used for sows and piglets. Pigs are provided with a rich source of local feed at an affordable price. However, for self-mixed feed, paying attention to food safety hazards due to mycotoxins, or possibly heavy metal residues from purchased raw materials is necessary. For mixed feed purchased from outside, paying attention to the risk of antibiotic residues exceeding the allowable limit is necessary.
- (2) *Production:* Food safety hazards from drinking water for pigs in case households/farms feed pigs with well water. Even households/farms that use tap water need to pay attention to cleaning the pipes leading to the automatic faucets, avoiding the moss that gives rise to anaerobic bacteria. Pay attention after washing the barn to wipe the wiper to avoid the situation that pigs can drinking this washing water, and there may be heavy metal residues and bacteria.
- (3) *Disease treatment:* In order to minimize disease in pigs, pig raising farmers use disinfection and sanitation measures in eating and drinking places, covered in cold seasons and ventilated in hot seasons to create an airy environment for pigs, limiting the harsh conditions that cause fatigue for pigs. However, there is still a food safety hazards when purchasing and/or using veterinary drugs that are not appropriate in terms of drug type, dosage, and drug withdrawal time before slaughter. Farmers should also pay attention to control antibiotic residues in pork.
- (4) *Living condition:* at the pig raising farms/household, pigs are raised in a closed, well-ventilated farm; especially in Son Phu, pigs are raised on microbial padding. Hoang Long Cooperative uses a cooling system, pumps water into the cooler and has a good ventilation fan. Cleaning of the barn is done regularly: daily or every few days. It is important to pay attention to the food safety hazard when workers and visitors do not follow the disease prevention process.

Checking/inspection

The surveyed slaughterhouses check and take samples for testing every 6 months at the request of the government agencies and at the request of customers, and for the control of food safety. Sampling at the farm is paid by the cooperative, or sometimes by the farmers.

Slaughterhouses

The inspection of slaughtering process to ensure food safety is summarized in Table 8.

Table 8: Expected steps of slaughtering process

Step	Activity	Check step
1	Prod pig	Recordkeeping of all processes
2	Clean pig	Do sensory check: pigs are cleaned, without impurities
3	Check	Do sensory check: pigs are cleaned, no soil, sand, garbage,
4	Render and bleed	Check electric strength: strength 400-500V
5	Scald and skin removal	Do sensory check: all hair has been removed. Check water temperature to ensure temperature at 70-75oC Frequency to check water temperature: 60 minutes.
6	Eviscerate internal organs	Do sensory check: ensure 100% of internal organs are removed from pigs
7	Cut head	Do sensory check: ensure that heads of 100% of pigs are cut
8	Check	Do general check of organs, cut heads and elasticity of meat, check if there are matters and abnormally livid spots, and review cleanliness of carcasses meat. Ensure 100% of carcass meet the quality and food safety standard before they are transferred to the slicing area.
9	Transport	Check the sanitary condition of the transport vehicle. Check personal hygiene of workers
10	Keep record	Keep record from pig production to transportation

Source: Survey data, 2023

At Hoang Long Cooperative, the slaughterhouse is close to the livestock area, there may be a food safety hazard due to air pollution from the pig barn to the slaughter area. At Son Phu Cooperative, the facilities of the slaughter area (roof, walls, floor) are old, there is a phenomenon of deterioration; risk of rats, bacteria entering, broken floors in some places can create a food safety hazard to meat. The treatment of wastewater and solid waste must ensure food safety to avoid contamination of meat. For both Hoang Long and Son Phu, equipment, tools, and protective clothing should be cleaned and disinfected after each slaughter. Slaughtering procedures need to be more clearly assigned among slaughterers, avoiding the risk of food safety being transmitted from dirty areas (epilation, hair removal, etc.) to clean areas (slicing, preliminary processing, processing). Persons directly involved in slaughtering, preliminary processing and processing of pork meat also need to pay attention to comply with health regulations and perform hygiene procedures before, during and after the slaughter, preliminary processing, and processing processes to reduce the risk of disease transmission from pigs to humans. For Vinh Anh, it is necessary to pay attention to the risk of cross-contamination of the disease in the barn waiting for slaughter from different sources of pigs.

Transportation

Pork from Son Phu, Hoang Long and Vinh Anh is transported by refrigerated trucks to shops and collective kitchens/catering companies that are regular customers of the cooperatives. The processes in the cooperatives are relatively closed and interconnected. However, it is necessary to pay attention to food safety hazards caused by packaging materials, and only use packaging materials that meet food safety criteria according to QCVN 12-1:11/BTY standards of the Ministry of Health for plastic packaging and tools

in direct contact with food. Delivery staff must comply with protective equipment (gloves, masks, clothes, ...) during delivery.

Processing

At the slaughterhouses of Son Phu and Hoang Long Cooperatives, part of the pork is used as raw material to produce ham and sausage at the cooperatives because they utilize meat that has suitable physical properties for the products.

The meat is processed in an isolated area which is next to the slaughterhouse, equipped with cold storage, arranged a small and medium meat processing area, ensuring a one-way processing process to facilitate the cleaning process.

Retail stores

Means of sale, items containing pork meat and products need to be made of stainless materials, easy to clean, disinfect and decontaminate. Sellers need to have appropriate preservation measures to ensure quality, reduce the risk of food safety and deterioration. Tools and items need to be cleaned before, during and after sale, and periodically need to be disinfected.

Quality and food safety certification

To be certified, households and cooperatives must meet the relevant requirements. They are assessed and certified if they fully meet the certification requirements in terms of infrastructure, management processes, food safety assurance and additional quality requirements.

At the surveyed pork chain of Son Phu, Dong Tam, Hoang Long and Vinh Anh, the certificates include the Certificate of Food Hygiene and Safety; VietGAHP Certificate, HACCP certificate issued by Hanoi Agricultural Products Quality and Certification and Analysis Center (Hanoi AgriCert); OCOP 3–4-star certificate and ISO 22000 certificate.

Achieving these certificates is not only to meet customers' requirements, helping the slaughterhouses maintain customers with high demand, but also to help them to improve their working processes and control hazards effectively.

However, the leaders of these cooperatives are not yet aware that training before and after certification will benefit their farms/households' members, as they may not yet be aware that the application of certified quality systems can improve obviously the quality and management processes.

Hoang Long Slaughterhouse applies and is granted a food safety management system certificate following ISO 22000 standards. However, the cooperative has not provided a food safety assurance plan (PRP, OPRP). This affects the efficiency and effectiveness of the ISO 22000 system being applied there. In addition, the cooperative does not show a record of meat preliminary processing in the clean room. This also affects the accuracy, authenticity, and efficiency of the ISO 22000 system/product traceability.

4.5 Gaps and Opportunities to enhance gender mainstreaming in pork value chains.

The role of men and women in the pig production chains.

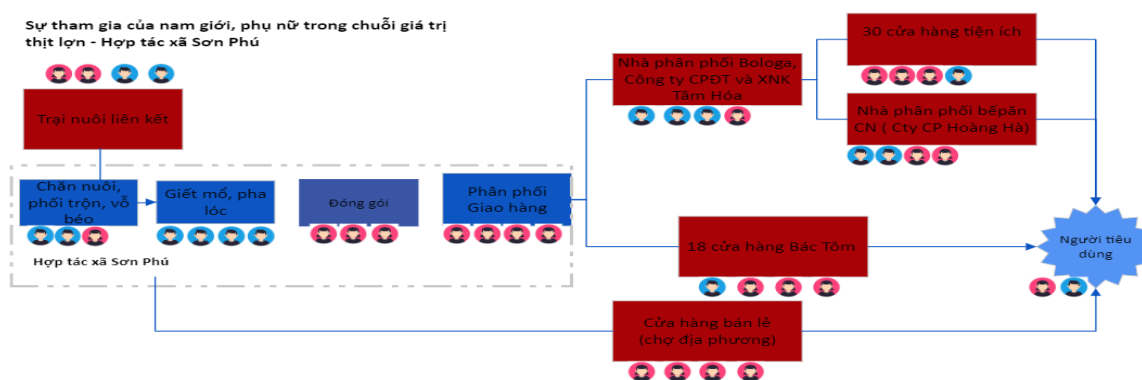
Participation of men and women: In the surveyed chains, both men and women are involved in pig production, of which women account for a higher percentage. However, at each stage in the chain, the

division of labor between men and women in the family and community is mainly based on the traditional stereotypes. Men and women must do the jobs deemed appropriate to their gender roles.

Particularly, at the stage of pig caring, both men and women participate equally. Their successful participation in pig production also confirms their roles and contribution to the household economy¹⁰. The division of labor by gender is the most obvious at the slaughtering stage, slicing, processing, and sales. In the surveyed chain, men play a major role in slaughtering and slicing. Men also do what is considered hard work like building pigsties and treating sick pigs. Women do what is considered lighter work such as pigsty cleaning, feeding, packing, distribution and especially retail. Participants in the group discussion thought that slaughtering and slicing were very hard work, requiring strength. For traditional slaughtering, women are not healthy enough to do these jobs. However, for industrial slaughtering as implemented in Hoang Long's chain, women still participate in this stage, mostly slicing stage.

Participants in the discussion thought that women were very suitable to play a key role in such stages as packing, marketing, and product sales. Representatives of Uncle Shrimp (18 stores) and BOLOGA (30 stores) said that more than 90% of their store managers and staff in this stage are women. The representative of Uncle Shrimp chain said that it was a very apparent division of labor based on gender characteristics. Women are often meticulous and skillful in communicating with customers and selecting products. They are responsible for the kitchens at home, so they understand the customers' tastes better. As a result, managers of stores are usually women. No men apply, even if a business wants to employ a man for that position. We believe that the labor division based on the need and abilities of each gender will help optimize their ability and will have more opportunities to get success in that position.

Figure 8: Participation of men and women in the pork value chain of Son Phu Cooperative



Source: Survey data, 2023

Right to make decisions: Decision-making is the point where the gender gap is the most obvious, influenced by many factors, including the access to and control of resources and community expectations about men

¹⁰ Son Phu Cooperative was established by a family under the cooperative law. The members of the cooperative are also family members including father, mother, son, daughter, daughter-in-law, in-law, and close relatives.

and women. Various consultations showed that discussion between men and women take place in different stages of the pork value chains. However, the proportion of men who are the final decision-makers is still higher than that of women. For example, women are responsible for almost all the product distribution, supply, and pricing. However, how to reinvest the earnings from product sale is decided by the Deputy Director of the cooperative, who is a man and the head of his household. The larger the scale of production is, the more men are involved in the production and hold final decision-making positions. Most of the decisions related to the selection of pig breeds and link with producers, businesses and slaughterhouses are made by men.

"I am the head of my household and the deputy director of the cooperative, I have the most experiences (20 years working in the cooperative), so I will be the final decision maker. My wife and children must respect my decision. For example, when I say how many pigs and how much material to buy, the members in the related stage must follow my decision" (in-depth interviewee, Nguyen Van Soi, Deputy Director of Son Phu Cooperative).

The analysis of Son Phu Cooperative pork production chain shows that women's participation in decision-making in some production sectors has helped enhance their relationships with men and promoted gender equality in the production chain. To participate more in the value chain, women need to be provided with such knowledge as taking care of pigs, especially on the use of veterinary medicine and vaccination for pigs. Regarding food safety, the survey results show that both women and men have no difficulties in accessing the information sources related to food safety. Both men and women in Son Phu Cooperative are required to attend annual training courses on food safety and hygiene, organized by the District Economic Bureau. Similarly, although veterinary services are available in the province/district, women still need more training to detect and treat diseases. As analyzed, many women are involved in the pig production. Not all the women have sufficient knowledge and skills for disease prevention. It is partly because they are not sufficiently trained in these issues and partly because men have more experience in this field.

Table 9: Frequent decision-makers for activities of the surveyed pork value chain

Activity	Son Phu	Dong Tam	Hoang Long	Vinh Anh
Processing				
<i>Slaughtering</i>	Men	Men	Men	Men
<i>Slicing</i>	Men	Men	Men	Men
<i>Transportation</i>	Men	Men	Men	Men
<i>Isolation</i>	Men, Women	Men, Women	Men, Women	Men, Women
<i>Pig reception</i>	Men, Women	Men, Women	Men, Women	Men
<i>Waste management</i>	Women	Women	Women	Men, Women
Preservation, sales, hygiene, and food safety				
<i>Application of technology to preservation</i>	Women	Women, men	Women	Men, Women
<i>Record keeping for traceability</i>	Women	Women, men	Women	Women
<i>Profit-cost accounting</i>	Men, Women	Men, Women	Men, Women	Women

Activity	Son Phu	Dong Tam	Hoang Long	Vinh Anh
<i>Quality monitoring and food safety</i>	Men	Men	Men	Men, Women
<i>Participate in training on food safety (who attend training?)</i>	Men	Men	Men	Men, Women
<i>Finding customers</i>	Men	Men	Men	Men, Women
Access to and control of resources (information, food safety policies, loans)				
<i>Seeking information and policies on food safety</i>	Men	Men	Men, Women	Men, Women
<i>Loan</i>	Men	Men	Men	Men
<i>Contract signing</i>	Men	Men	Men	Women
<i>Decision on what kind of pigs to buy</i>	Men	Men	Men	Men, Women
Other (specify)				
Are there any prejudices about slaughtering? (e.g., men transport, women clean...)	Men, Women	Men, Women	yes	yes, women do bookkeeping, men slaughter
Is there a preference policy for men and women at the slaughterhouse?	Men, Women	Men, Women	no	As regulated by the Government (maternity leave,)

Source: Survey results, group discussion (2023)

Information from the group discussion showed that women seem more cautious about chemical residues in pork/food and are more concerned about food-related illnesses than men. These findings are significant because they influence the project's interventions to better engage with women to meet their needs. The research showed positive signs regarding decision-making in the production process in the surveyed communes. The fact that women actively participate in production shows their increasing role in economic activities, especially in small-scale production of Son Phu. This finding is similar to the research on pig production chains at household scale in Lao Cai, conducted by Oxfam in 2011. The knowledge and experience¹¹ the women gain in the production process help them do their jobs and have a stronger voice in the decision-making process in pig production.

The research shows that gender dimensions such as the need, concerns and challenges of men and women when participating in pig production activities have not been fully integrated in current policies. This will limit the expected impact of policies and women's potential and economic leadership.

¹¹ *Upgrading local Black Pig Value chains in Bat Xat and Muong Khuong Districts of Lao Cai Province*, Oxfam Great Britain, 2011

4.6 Environment and climate change

4.6.1 Climate change and its impact on Vietnam's agriculture

Climate change is a terminology used to refer to a change in the global climate system including the earth's climate, subsoil climate, and oceanic climate over a long period of time i.e. 10 year cycles or longer. Climate change includes changes in temperature and weather cycles which can be explained by natural causes but are primarily due to human socioeconomic activities with the excessive use of fossil fuels such as oil, coal, gas; such activities of industrial, transport, tourism, construction, land use, reduced forest area and increased agricultural intensification practices (IPCC, 2022). These activities have caused greenhouse gases (GHG) including the pressure of CO₂, CH₄, N₂O, and many other greenhouse gases in the atmosphere and resulted in rapid global warming process.

Climate change is the cause to the increase of extreme weather phenomena: too hot or too cold, prolonged drought or flood, rain with very high frequency and intensity in a short time. This has seriously affected the agro-ecosystem. As a result, climate change poses serious threats to food security, agricultural and food safety, and biodiversity, which are also threats to sustainable development goals of the world in general and of Vietnam in particular. Agricultural losses due to climate change in Vietnam are expected to amount to 5.6–6.2% in 2030 and 7.6–10.6% in 2050, depending on different climate scenarios. Notably, without climate change, overall agricultural output of Vietnam is expected to increase by 25% during 2010 - 2030 and 36% by 2050. Hence climate change impacts will deprive Vietnam of a large part of its agricultural productivity gains. Reduced crop yields can also lead to higher food prices, particularly impacting low-income people (WB, 2022).

4.6.2 Impacts of climate change on pork value chains and climate smart practices in livestock production

Climate change affects the growth of cattle and poultry: damaging and extreme cold in winter resulting mass death of cattle and poultry; prolonged hot summer and water shortage reducing economic efficiency of livestock production.

Changes in climate and weather factors have given rise to a number of new diseases for livestock and poultry production which developed into epidemics or pandemics in recent years, including avian flu; pig blue ears, foot-and-mouth disease etc. and many diseases which can be transmitted to humans, causing dangerous diseases.

Survey results on climate change impacts on pork chain in recent years in Hanoi showed that: Livestock are more stressed and more susceptible to diseases due to rising temperatures. Livestock waste causes stink and is more difficult to be managed in the summer, hot days and rainy days. The transporting of livestock and pork becomes more difficult in extremely hot or in unusually rainy days.

Livestock contamination and sanitation of stables are among food safety and hygiene concerns regarding small-scale livestock production and slaughtering houses. Livestock isolation and safety have not been strictly controlled.

Energy saving activities have not really been noticed in most small-scale livestock production chains. Pig raising households tend to switch from biogas-produced liquid livestock waste management method to solid waste treatment using biological buffers. Reuse of livestock waste for planting has been initially adopted.

No CSA model for pig production has been applied. Awareness on climate change exists but responses are passive. Climate smart technologies are not well applied; Separation of waste at source has not been fully practiced. Cropping and livestock production linkages are available but not yet developed into standard operational procedures or systems.

4.7 Traceability

The current bookkeeping in Son Phu, Hoang Long and even Vinh Anh mainly serves the financial management of the cooperatives. This is also part of the traceability system but is incomplete. Incoming and outgoing products can be identified in the supply of meat to large customers such as collective kitchens/catering companies and supermarkets. The identification of the product lots is based on their invoice and documents but links to the farm of origin are lacking.

The interviews of the owners and product quality managers show that the surveyed actors have knowledge of traceability and define cases where products must be recalled as the products do not meet the requirements for sensory quality/packing and labeling. The labeling content complies with Decree 43/2017/ND-CP (product name, product photo, establishment name and address, contact phone; storage instructions). However, there is no QR code or barcode on the label for product traceability. Therefore, the surveyed actors have not applied traceability technology solutions based on QR code, GS1. The products supplied to Ha Dong and Long Bien Aeon mall, have additional typical labels.

If a complaint about food safety arises, the chain actors and the customer agree to take samples and send samples to a laboratory for analysis. The related parties will rely on the analysis results to agree on the recall and destruction of products if chemical and antibiotic residues are detected. However, the establishments have not updated the regulations on traceability, recall and handling of unsafe food in accordance with Circular 17/2021/TT-BNNPTNT and have not been instructed or communicated by relevant food safety management agencies.

At the same time, there does not have enough database of tracing back or forward at 2 stages namely slaughtering, slicing and packing for the production households/farms because they have not updated information about the identification number of slaughtered pigs in the agreed form at the slaughtering stage; have not updated information to track from semi-finished products to finished products at the stage of slicing, packing of the meat from each pig identified at the slaughtering stage.

5 CONCLUSIONS AND RECOMMENDATIONS

The pork value chain surveyed in Hanoi city has reviewed the main functions of input supply, production, slaughtering/processing, and distribution, performed by relevant actors, where each actor may perform one or more than one functions, and they link together quite tightly. Products of the chain are supplied to local markets/retail stores, commercial centers, supermarkets, convenience stores and collective kitchens/catering companies and directly to consumers through online channels. In particular, the distribution channel of cool meat (cold chain) to the system of commercial centers, supermarkets, convenience stores...and collective kitchens/catering companies plays an increasingly important role. Distributors play a relatively important role of coordinating the whole chain. Members of the chain are now facing certain difficulties in managing and controlling food safety, market development, traceability, CSA practices, and gender gaps in the development process.

The value chain linkage of Son Phu and Dong Tam Cooperative has created benefits for all actors in the chain, from producers, slaughterhouses, distributors, and consumers, including local consumers. The linkage between the actors in the chain is relatively tight, sharing benefits and risks on a win-win basis. Cooperative members have capacity, understand the communication needs and ability on food safety, recognize the impacts of climate change and initially implement solutions to mitigate negative impacts on the environment. Cooperative members participate in social activities; are aware of change and innovation and ready to participate in the project. Although the cooperative plays a central role in connecting the chain, distributors play an important role in coordinating and leading the chain. Potential food safety hazards exist in some stages, the scale is still small (households), the horizontal linkage in production remains limited, and the record-keeping, and traceability are still incomplete and improper. Even though this cooperative can be considered as one of the typical models to promote similar startups to other districts of Hanoi. Experience in establishing and scaling up the linkage model between production and distribution systems must also be widely introduced to promote other start-up models. Additional improvements are needed at all stages in the chain.

The farm-to-folk pork chain model of Hoang Long Cooperative has created relatively good benefits to the actors participating in the chain, from producers/slaughterers, distributors, and consumers. The cooperative leaders have management capacity, knowledge about production, slaughtering, food safety and traceability. However, food safety hazards exist in some stages, the horizontal linkage in production remains limited, the record keeping, and traceability are still incomplete and improper. Even though, this farm-to-folk model can be considered as one of the good models to stimulate similar models in other districts of Hanoi. Experience in establishing and scaling up the farm-to-folk model and linkage between production and distribution systems needs to be widely introduced to promote other start-ups. Additional improvements are needed at all stages in the chain. Training for satellite farms should be supported. Traditional product processing and product diversification should be promoted to increase the value added for chain actors. A CSA pilot model for other startups to follow should be developed.

The relatively large-scale supply chain model of Vinh Anh company has also brought many benefits for the actors in the chain, from producers, slaughterhouses, distributors, and consumers, in food safety and

economic benefit. The chain also creates favorable conditions for sustainable development for all the actors. The leader of the chain is the slaughterhouse who has management capacity, knowledge and experience in slaughtering, food safety and traceability. However, the linkage backward to the producers and forward to the consumers is still loosen. Therefore, the slaughtering capacity is low (15-30%), leading to low effectiveness. This difficulty originally results from the limited number of people with cool/cold meat consumption habits in Hanoi. Communication should be enhanced to help people recognize the benefit of cool/cold meat consumption. This chain can be considered one of the typical chain models to replicate in other districts of Hanoi to obtain the objective of Hanoi in reducing and limiting small-scale slaughtering with bad food safety hygiene in residential areas.

To promote and develop a sustainable pork value chain, towards international standards, some interventions are proposed as follows:

Recommendation:

The establishment and development of the pork value chain must consider distribution enterprises as the key actors, and cooperatives and cooperative groups as factors to connect farmers; local authorities should promote and support the development of chains.

It is necessary to develop livestock production with biosecurity, disease control, and reduction of veterinary costs. Standards, procedures, and guidelines on biosecurity in livestock production for farm-scale livestock and household production should be developed. Food safety could be considered as the core factor for sustainable development of livestock production.

Promotion and development of pork value chains is needed to ensure food safety. Communication needs to be promoted. Production procedures, instructions, supervision, and inspection the producers' application should be developed to ensure food safety. Application of VietGAHP in animal production should be enhanced. HACCP and ISO 22000 certification for slaughterhouses and processors should be promoted. Training for livestock producers, slaughterhouses, processors, wholesalers, and consumers on food safety should be implemented.

Intervention proposal for the chain:

Table 10: Intervention proposal within the SAFEGRO framework.

Actors	Son Phu	Dong Tam	Hoang Long	Vinh Anh
Pig-raising farmers	Consult, and redesign infrastructure to comply with food safety regulations and standards; Support for small tools/equipment (doors, walls, barn	Consult, and redesign infrastructure to comply with food safety regulations and standards; Support for small tools/equipment (doors, walls, barn	Support for small tools/equipment to upgrade the farm, ensure standards	

Actors	Son Phu	Dong Tam	Hoang Long	Vinh Anh
	floors, roofs, fans, etc.) to upgrade and meet standards.	floors, roofs, fans, etc.) to upgrade and meet standards.		
	Support VietGAHP and other certifications (including lab analysis of water and feed samples)	Support VietGAHP and other certifications (including lab analysis of water and feed samples)	Support VietGAHP and other certifications (including lab analysis of water and feed samples)	Support VietGAHP and other certifications (including lab analysis of water and feed samples)
	Improve capacity of farmers, including women farmers, on biosafety livestock production, processes, VietGAHP, animal welfare, CSA practice, nutrition, feed mixing, use of antibiotics and veterinary drugs, vaccines	Improve the capacity of farmers, including women farmers, on biosafety livestock production, processes, VietGAHP, animal welfare, CSA practice, nutrition, feed mixing, use of antibiotics and veterinary drugs, vaccines	Improve the capacity of farmers, including women farmers, on biosafety livestock production, processes, VietGAHP, animal welfare, CSA practice, nutrition, feed mixing, use of antibiotics and veterinary drugs, vaccines	Improve the capacity of farmers, including women farmers, on biosafety livestock production, processes, VietGAHP, animal welfare, CSA practice, nutrition, feed mixing, use of antibiotics and veterinary drugs, vaccines
Slaughterhouses	Support to establish and apply of HACCP standards	Support to establish and apply of HACCP standards	Support in maintaining ISO 22000	Support in maintaining ISO 22000
	Improve the capacity of planning; animal welfare, and slaughter practices, gender mainstreaming	Improve the capacity of planning; animal welfare, and slaughter practices, gender mainstreaming	Improve the capacity of slaughtering, gender mainstreaming	Gender mainstreaming
	Consult, design, and support small tools/equipment to comply with food safety regulations and standards for slaughterhouses		Support to upgrade waste treatment system	

Actors	Son Phu	Dong Tam	Hoang Long	Vinh Anh
Distributors	The project cooperates with supermarkets/convenience stores to practice tracing and recalling products when food safety incidents occur at supermarkets/convenience stores	The project cooperates with supermarkets/convenience stores to practice tracing and recalling products when food safety incidents occur at supermarkets/convenience stores	The project cooperates with supermarkets/convenience stores to practice tracing and recalling products when food safety incidents occur at supermarkets/convenience stores	The project cooperates with supermarkets/convenience stores to practice tracing and recalling products when food safety incidents occur at supermarkets/convenience stores
	Improve the capacity of supply planning; management, market access, online sales, marketing, and information technology, gender mainstreaming.	Improve the capacity of supply planning; management, market access, online sales, marketing, and information technology, gender mainstreaming.	Improve the capacity of supply planning; management, market access, online sales, marketing, and information technology, gender mainstreaming.	Improve the capacity of supply planning; management, market access, online sales, marketing, and information technology, gender mainstreaming.
	Support for brand development: strengthen the identification system with billboards, posters, and handbooks, participate in promotional programs; write promotional articles, leaflets, videos, and market test models, on-site display screens	Support for brand development: strengthen the identification system with billboards, posters, and handbooks, participate in promotional programs; write promotional articles, leaflets, videos, and market test models, on-site display screens	Support for brand development: strengthen the identification system with billboards, posters, and handbooks, participate in promotional programs; write promotional articles, leaflets, videos, and market test models, on-site display screens	Support for brand development: strengthen the identification system with billboards, posters, and handbooks, participate in promotional programs; write promotional articles, leaflets, videos, and market test models, on-site display screens
Collective kitchens	Train parents, students, and teachers, including females and girls, knowledge of food safety and skills to	Train parents, students, and teachers, including females and girls, knowledge of food safety and skills to	Train parents, students, and teachers, including females and girls, knowledge of food safety and skills to	Train parents, students, and teachers, including females and girls, knowledge of food safety and skills to

Actors	Son Phu	Dong Tam	Hoang Long	Vinh Anh
	inspect, test and evaluate suppliers.	inspect, test and evaluate suppliers.	inspect, test and evaluate suppliers.	inspect, test and evaluate suppliers.
	Train kitchen staff and kitchen managers (gender mainstreaming), knowledge and skills on food safety in preliminary processing, processing, and preservation	Train kitchen staff and kitchen managers (gender mainstreaming), knowledge and skills on food safety in preliminary processing, processing, and preservation	Train kitchen staff and kitchen managers (gender mainstreaming), knowledge and skills on food safety in preliminary processing, processing, and preservation	Train kitchen staff and kitchen managers (gender mainstreaming), knowledge and skills on food safety in preliminary processing, processing, and preservation
	Improve the capacity of handling procedures when food safety incidents occur in the collective kitchen	Improve the capacity of handling procedures when food safety incidents occur in the collective kitchen	Improve the capacity of handling procedures when food safety incidents occur in the collective kitchen	Improve the capacity of handling procedures when food safety incidents occur in the collective kitchen
	Consult, and redesign facilities to ensure compliance with food safety regulations and standards	Consult, and redesign facilities to ensure compliance with food safety regulations and standards	Consult, and redesign facilities to ensure compliance with food safety regulations and standards	Consult, and redesign facilities to ensure compliance with food safety regulations and standards
Leaders of cooperatives/enterprises	Establish and manage digital technological applications databases	Establish and manage digital technological applications databases	Establish and manage digital technological applications databases	Support cooperatives to build and manage databases based on digital technology applications
	Improve the capacity of production and supply planning; disease control and food safety; waste treatment of the pig-raising and	Improve the capacity of production and supply planning; disease control and food safety; waste treatment of the pig-raising and	Improve the capacity of production and supply planning; disease control and food safety; waste treatment of the pig-raising and	Gender mainstreaming

Actors	Son Phu	Dong Tam	Hoang Long	Vinh Anh
	slaughtering activities; management, market access, online sales, marketing, and information technology, gender mainstreaming.	slaughtering activities; management, market access, online sales, marketing, and information technology, gender mainstreaming.	slaughtering activities; management, market access, online sales, marketing, and information technology, gender mainstreaming	
	Support to establish and develop the brand (a website, logo, identity system, participation in promotional programs, design promotion programs...)	Support to establish and develop the brand (a website, logo, identity system, participation in promotional programs, design promotion programs...)	Support to establish and develop the brand (a website, logo, identity system, participation in promotional programs, design promotion programs...)	Support for brand development (strengthening the identity system with billboards, posters, handbooks, participating in promotional programs; writing promotional articles, leaflets, videos, sample demonstration models (market test)
All actors in the chain	Support a CSA model with energy saving, cold tools, solid and liquid waste management and treatment, waste reuse for farming.	Support a CSA model with energy saving, cold tools, solid and liquid waste management and treatment, waste reuse for farming.	Support a CSA model with energy saving, cold tools, solid and liquid waste management and treatment, waste reuse for farming.	Support a CSA model with energy saving, cold tools, solid and liquid waste management and treatment, and waste reuse for farming.
	Support to connect actors in the chain with potential consumers to expand market opportunities	Support to connect actors in the chain with potential consumers to expand market opportunities	Support to connect actors in the chain with potential consumers to expand market opportunities	Support to connect actors in the chain with potential consumers to expand market opportunities
	Guide farmers to apply the traceability system of the project	Guide farmers to apply the traceability system of the project	Guide farmers to apply the traceability system of the project	Guide farmers to apply the traceability system of the project
	Build a network of key gender officers	Build a network of key gender officers	Build a network of key gender officers	Build a network of key gender officers in all



Actors	Son Phu	Dong Tam	Hoang Long	Vinh Anh
	in all department/partners/actors participating in the VC. Select those who are willing to integrate gender into their department	in all department/partners/actors participating in the VC. Select those who are willing to integrate gender into their department	in all department/partners/actors participating in the VC. Select those who are willing to integrate gender into their department	department/partners/actors participating in the VC. Select those who are willing to integrate gender into their department

Reference

1. ACIAR. Reducing disease risk and improving food safety in smallholder pig value chains in Vietnam. Project fact sheet (in English and Vietnamese). Reducing disease risks and improving food safety in smallholder pig value chains in Vietnam | ACIAR
2. ADB (2019). Greater Mekong Subregion Sustainable & Food Security Program. <https://www.adb.org/projects/documents/reg-53391-001-tar>
3. MOST (2017). Vietnam Standard, (TCVN) 11892-1:2017. Good Agricultural Practices. (VietGAP). <https://isoq.vn/vietgap/tcvn-11892-1-2017/>
4. MARD (2022). QCVN 01-195: 2022/BNNPTNT. National technical regulation on livestock wastewater used for crops. <https://thuvienphapluat.vn/van-ban/Tai-nguyen-Moi-truong/Thong-tu-28-2022-TT-BNNPTNT-Quy-chuan-ky-thuat-nuoc-thai-chan-nuoi-su-dung-cho-cay-trong-548679.aspx>
5. MONRE (2016). Climate change and sea level rise scenario of Vietnam. Vietnam Publishing House of Natural Resources, Environment and Cartography, 2016
6. MONRE (2020). Climate change and sea level rise scenario of Vietnam. Vietnam Publishing House of Natural Resources, Environment and Cartography, 2020.
7. MONRE (2022). Third Country Report for United Nations Framework Convention on Climate Change.
8. Claudia Wagner-Riddle (2022). The Role of Soil in reaching net-zero agriculture. Communication presented at the VinFuture Prize Award Week, Hanoi, Dec.2022.
9. Claudia Wagner-Riddle (Đại học Guelph, Canada) . The Role of Soil in reaching net-zero agriculture. Communication presented at VinFuture Prize Week, Hanoi, Dec.2022.
10. Dang Thi Be. 2016. Development of pig production following Vietnamese Good Animal Husbandry Practices (VietGAHP) guidelines in the area of Dien Chau District, Nghe An Province. MSc thesis. Hanoi, Vietnam: Vietnam National Agricultural University. <http://hdl.handle.net/10568/80367>
11. European Commission (EU,2019). A smart sustainable digital future for European Agriculture and Rural Areas. <http://digital-strategy.ec.europa.eu/news/eu-member-states-join-forces-digitalisation-european-agriculture-and-rural-areas>
12. FAO, Climate Smart Agriculture Sourcebook, truy cập ngày 4/1/2023 tại <https://www.fao.org/climate-smart-agriculture-sourcebook/concept/module-a1-introducing-csa/chapter-a1-2/en/>
13. Grace, D. 2015. Food safety in developing countries: An overview. Hemel Hempstead, UK: Evidence on Demand. <http://hdl.handle.net/10568/68720>
14. Grace, D., Lapar, M.L. and Fahrion, A. 2012. Risk assessment of pork value chain in peri-urban Hanoi. Asian Journal of Agriculture and Development 9(3): 84. <http://hdl.handle.net/10568/51362>

15. Hank van der Berg (2014). IPM Farm Field Schools. A Synthesis of 25 impact evaluation. Wageningen University. 2014.
16. Government of Canada. 2022. Gender-based analysis plus. <https://women-gender-equality.canada.ca/en/gender-based-analysis-plus/resources/research-guide.htm>
17. EY. 2021. Digital-based Food Traceability system for Fruit and Vegetable Supply Chains in Vietnam. https://www.ey.com/en_vn/ey-events/digital-based-food-traceability-systems-for-fruit-and-vegetable-
18. FAO. 2001. Curriculum Development for Plant Pest Management in Asia Pacific. <https://www.fao.org/3/ac461e/AC461E00.htm#TOC>
19. FAO. 2017. Climate Smart Agriculture Sourcebook. <https://www.fao.org/climate-smart-agriculture-sourcebook/en/>
20. Hung Nguyen-Viet, Sinh Dang-Xuan, Phuc Pham-Duc, Roesel, K., Nguyen Mai Huong, Toan Luu-Quoc, Pham Van Hung, Nguyen Thi Duong Nga, Lapar, L., Unger, F., Häsler, B., Grace, D. 2019. Rapid integrated assessment of food safety and nutrition related to pork consumption of regular consumers and mothers with young children in Vietnam. *Global Food Security*. 20, 37-44. <http://hdl.handle.net/10.1016/j.gfs.2018.12.003> Final report: Reducing disease risks and improving food safety in smallholder pig value chains in Vietnam Page 44
21. IFAD (2015). How to do climate change risk assessment in value chain project.
22. ILRI. 2012. Reducing disease risk and improving food safety in smallholder pig value chains in Vietnam. ILRI Project Profile. Nairobi, Kenya: ILRI. <http://hdl.handle.net/10568/21706> Final report: Reducing disease risks and improving food safety in smallholder pig value chains in Vietnam Page 53
23. ILRI. 2013. Reducing pig diseases and improving food safety in smallholder pig value chains in Vietnam: Report of the inception workshop held at Hanoi, Vietnam 12–14 August 2012. Nairobi, Kenya: ILRI. <http://hdl.handle.net/10568/33297>
24. ILRI. 2017. Reducing disease risks and improving food safety in smallholder pig value chains in Vietnam (PigRisk). ILRI Project Update. Nairobi, Kenya: ILRI. <http://hdl.handle.net/10568/89007>
25. Johnson, N.L., Mayne, J., Grace, D. and Wyatt, A. 2015. How will training traders contribute to improved food safety in informal markets for meat and milk? A theory of change analysis. IFPRI Discussion Paper 1451. Washington, DC: IFPRI. <http://hdl.handle.net/10568/67735>
26. Lam, S., Unger, F., Barot, M. and Hung Nguyen-Viet. 2016. Changes in researcher capacity in assessing Food safety hazards and value chains: Insights from PigRisk team. ILRI Research Brief 64. Nairobi, Kenya: ILRI. <http://hdl.handle.net/10568/72926>
27. Nguyen Thi Duong Nga, Ho Ngoc Ninh, Pham Van Hung and Lapar, M.L. 2014. Smallholder pig value chain development in Vietnam: Situation analysis and trends. ILRI Project Report. Nairobi, Kenya: ILRI. <http://hdl.handle.net/10568>
28. Nguyen Thi Ly, Nanseki, T. and Chomei, Y. 2015. Determinants of biogas adoption in manure management of Vietnamese household pig production: A case research in Tien Lu District, Hung Yen Province. *Journal of the Faculty of Agriculture, Kyushu University* 60(2): 577–581. <http://hdl.handle.net/10568/76505>
29. Phạm Vũ Hải, Đào Thế Anh (2016). Food safety of agricultural products. Some knowledge on products, production and distribution systems and Government’s policies. Agricultural Publishing House. Hanoi. 2016.

30. R. Kaplinsky and M. Morris, *A handbook for value chain research*, Brighton, Institute of Development Studies, UK, Sussex University, 2001.
31. R. Kaplinsky, 'Globalisation and Unequalisation: What Can Be Learned from Value Chain Analysis', *The Journal of Development Studies*, Vol. 37, Issue. 2, 1999, pp. 117-146.
32. Rich, K.M., Dizyee, K., Huyen Nguyen, T.T., Ha Duong, N., Hung Pham, V., Nga Nguyen, T.D., Unger, F. and Lapar, M.L. 2018. Quantitative value chain approaches for animal health and food safety. *Food Microbiology*. <http://hdl.handle.net/10568/88200>
33. SAFEGRO (2022). *Environment Management Strategy. Project Implementation Plan*.
34. Sinh Dang-Xuan, Hung Nguyen-Viet, Meeyam, T., Fries, R., Huong NguyenThanh, Phuc Pham-Duc, Lam, S., Grace, D. and Unger, F. 2016. Food safety perceptions and practices among smallholder pork value chain actors in Hung Yen province, Vietnam. *Journal of Food Protection* 79(9): 1490–1497. <http://hdl.handle.net/10568/77065>
35. Sinh Dang-Xuan, Hung Nguyen-Viet, Phuc Pham-Duc, Grace, D., Unger, F., Nam Nguyen-Hai, Thanh Nguyen-Tien and Makita, K. 2018. Simulating Cross Contamination of Cooked Pork with *Salmonella enterica* from Raw Pork through Home Kitchen Preparation in Vietnam. *Int J Environ Res Public Health*. 15(10). <http://hdl.handle.net/10.3390/ijerph15102324>
36. Sinh Dang-Xuan, Hung Nguyen-Viet, Phuc Pham-Duc, Unger, F., Ngan Tran-Thi, Grace, D. and Makita, K. 2018. Risk factors associated with *Salmonella* spp. prevalence along smallholder pig value chains in Vietnam. *Int J Food Microbiol*. 290:105-115. <http://hdl.handle.net/10.1016/j.ijfoodmicro.2018.09.030>
37. Sinh Dang-Xuan, Hung Nguyen-Viet, Unger, F., Phuc Pham-Duc, Grace, D., Ngan Tran-Thi, Barot, M., Ngoc Pham-Thi and Makita, K. 2017. Quantitative risk assessment of human salmonellosis in the smallholder pig value chains in urban of Vietnam. *International Journal of Public Health* 62(Supplement 1): 93–102. <http://hdl.handle.net/10568/77739>
38. Sinh Dang-Xuan. 2018. Quantitative risk assessment of salmonellosis through pork consumption in Vietnam. PhD thesis in Veterinary Science. Hokkaido, Japan. Rakuno Gakuen University. <https://hdl.handle.net/10568/93449>
39. Thomas M.S. (2020). *Digital transformation*. General Publishing House, Ho Chi Minh City.
40. Tran Thi Tuyet-Hanh, Dang Xuan Sinh, Pham Duc Phuc, Tran Thi Ngan, Chu Van Tuat, Grace, D., Unger, F. and Hung Nguyen-Viet. 2017. Exposure assessment of chemical hazards in pork meat, liver, and kidney, and health impact implication in Hung Yen and Nghe An provinces, Vietnam. *International Journal of Public Health* 62(Supplement 1): 75–82. <http://hdl.handle.net/10568/77702>
41. Unger, F. 2016. Interventions along the value chain: Experience exchange. Report of a workshop held at Hanoi, Vietnam, 5 May 2016. Nairobi, Kenya: ILRI. <http://hdl.handle.net/10568/80059>
42. Unger, F., Hung Nguyen-Viet, Grace, D., Pham Van Hung, Nguyen Duong Nga, Nguyen Thi Thu Huyen, Pham Duc Phuc, Tran Thi Tuyet Hanh, Dang Xuan Sinh and Tran Thi Ngan. Food safety in the smallholder pig value chain in Vietnam: Understanding complexities and adjusting policies. ILRI Policy Brief 24. Nairobi, Kenya: ILRI. <http://hdl.handle.net/10568/91965>
43. World Bank (2022). *Vietnam Country Climate and Development Report*. Available online: <https://www.worldbank.org/en/news/video/2022/07/14/vietnam-country-climate-and-development-report-reconciling-economic-successes-with-climate-risks#:~:text=The%20World%20Bank%20Group's%20Country,high%2Dincome%20economy%20by%202045>.