

Identification of risk factors for African swine fever (ASF) along pig value chain in Lào Cai Province

By: Le Thi Thanh Huyen, Do Van Duc, and Han Anh Tuan

National Institute of Animal Science



Table of Contents

List of tables	4
Lists of figures	5
Introduction	6
Materials and methods	7
<i>Study area</i>	7
<i>Data collection</i>	9
<i>Key person interviews</i>	10
<i>Focus group discussions</i>	10
<i>Pig producer interviews</i>	11
<i>Stakeholder feedback workshop</i>	11
<i>Data analysis</i>	11
Results and discussions	12
1. <i>Pig production systems and the impacts of ASF outbreaks</i>	12
1.1. <i>Overview of pig production systems and impact of ASF in Bảo Thắng, Lào Cai Province</i>	12
1.2. <i>Pig production of interviewed farmers in Bảo Thắng District</i>	15
2. <i>Pig market systems and the impacts of ASF outbreaks</i>	18
2.1. <i>General information on pig market systems in Lào Cai Province and Bảo Thắng District</i> ...	18
2.2. <i>Major pig market systems and ASF impacts</i>	19
3. <i>Assessment of risk factors in transmission of ASF along the major pig value chains</i>	24
3.1. <i>Assessment of reasons for the transmission of ASF as assessed by local authorities</i>	24
3.2. <i>Adoption of animal health care and biosecurity practices in pig production</i>	25
3.3. <i>Perception of risk factors along the pig supply chain among pig producers in the study area</i>	27
4. <i>Capacity for diagnosis and monitoring of ASF and solutions for disease management</i>	31
4.1. <i>Resources, knowledge and practices of local authorities at different levels</i>	31
4.2. <i>Potential and constraints</i>	33
4.3. <i>Solutions</i>	36
5. <i>Training needs in the context of ASF</i>	41
Conclusion	43
References	43
Annexe	45

<i>Annex 1: Consent form</i>	45
<i>Annex 2: Interview with officers responsible for veterinary care and livestock production</i>	46
<i>Annex 3: Interview pig retailer</i>	48
<i>Annex 4: interview pig producers</i>	49
<i>Annex 5: Interview pig breeder</i>	58
<i>Annex 6: Interview Slaughterhouse</i>	67
<i>Annex 7: Interview pig collector and/ or transporter</i>	69
<i>Annex 8: FGDs with local officers</i>	70
<i>Annex 9: FGDs with farmers</i>	72
<i>Annex 10: list of participants attending the stakeholder feedback workshop</i>	75

List of tables

Table 1: Numbers of main livestock species in Lào Cai Province, 2018–2020.....	8
Table 2: Numbers of main livestock species in Bảo Thắng District, 2018–2020.....	9
Table 3: Summary of interview and FGD participant numbers.....	10
Table 4: Current pig herd in Lào Cai Province.....	12
Table 5: Major pig farm types and distribution in Bảo Thắng District, 2020.....	13
Table 6: Pig herd structure and numbers in Bảo Thắng District.....	13
Table 7: Impact of ASF on livelihoods of pig producers as evaluated by vet, livestock officers and agricultural extension workers.....	14
Table 8: Demographic information about interviewed pig producers.....	15
Table 9: Structure of pig herds in 2018 (before ASF outbreak) and 2020 by farm type.....	15
Table 10: Production cost of breeding a piglet litter currently and before ASF outbreak (year 2018), by farm type.....	16
Table 11: Costs and profits of a fattener by farm type.....	16
Table 12: Pig losses caused by ASF among the farms having pigs infected with ASF, by farm type.....	17
Table 13: Changes in pig output (slaughtered pigs) from 2018 to 2020 by farm type.....	17
Table 14: Changes in pig output (slaughtered pigs) from 2018 to 2020 by presence of ASF cases.....	18
Table 15: Number of biosecurity practices applied by pig producers in Bảo Thắng District.....	25
Table 16: Percentage of farms vaccinating their pigs against disease.....	27
Table 17: Rates of some biosecurity practices among interviewed pig producers.....	27
Table 18: Risks to the farms come from different actors.....	30
Table 19: Major difficulties of interviewed pig producers in restocking herds after ASF outbreaks.....	35
Table 20: Suggested technical and husbandry management measures to increase biosecurity and prevent disease on farms (Mean±SD).....	37
Table 21: Solutions for monitoring inputs and market risk factors suggested by pig producers.....	38
Table 22: Policies to support pig farms to overcome ASF as suggested by producers.....	38
Table 23: Training needs of interviewed farmers.....	41
Table 24: Training needs of farmers.....	42
Table 25: Training needs of vet and livestock officers.....	42

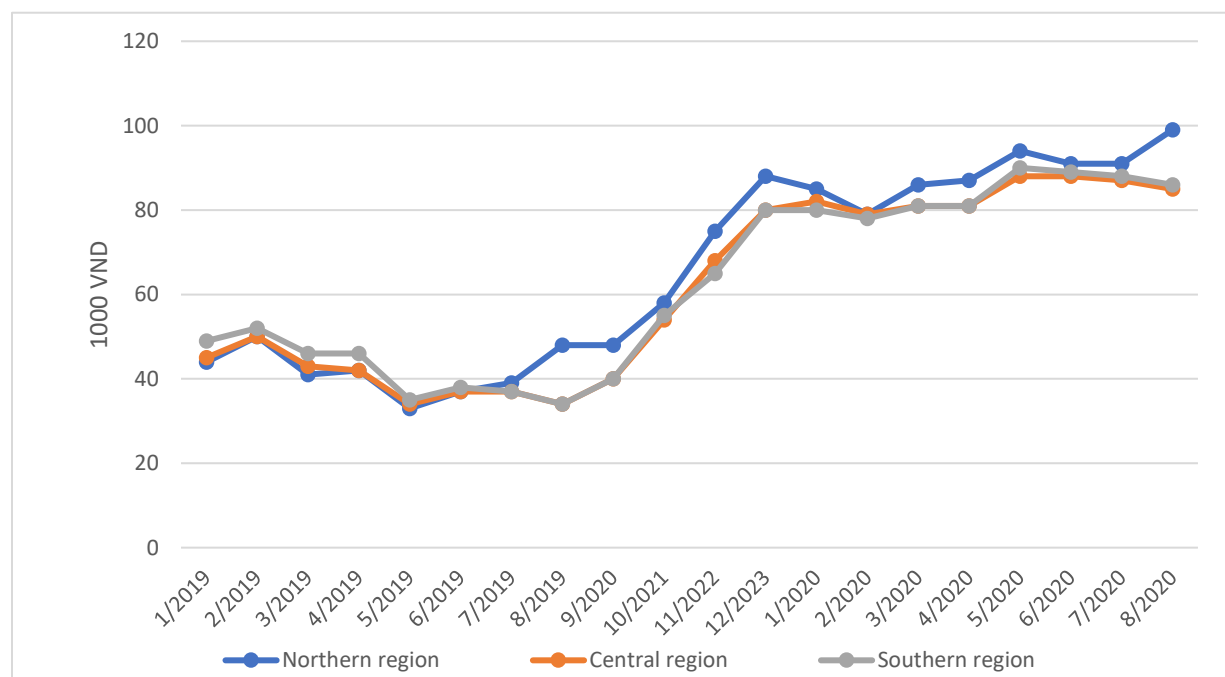
Lists of figures

Figure 1: Price of pigs in 1,000 Vietnamese Dong (VND)/kg live weight (LW) before and during ASF outbreaks in the northern, southern and central regions of Vietnam.	6
Figure 2: Study area: Bảo Thắng District and Lào Cai city, Lào Cai Province.	7
Figure 3: Live pig movement in and out of Lào Cai Province.	18
Figure 4: Major current provincial pig market systems involving collector-slaughterers and changes following ASF outbreaks.	20
Figure 5: Market system involved by a pig collector in Xuan Quang Commune, Bảo Thắng District	22
Figure 6: Major market system involving interviewed producers in Xuan Quang commune	23
Figure 7: Distribution of pig farms with and without cases of ASF over the number of biosecurity practices adopted.	25
Figure 8: Distribution of pig farms using and not using swill feeds over the number of biosecurity practices adopted.	26
Figure 9: Perceptions of danger of ASF transmission in the value chain among pig producers in the study area.	28

Introduction

In Vietnam, the first outbreak of African swine fever (ASF) occurred in February 2019 in Hung Yen Province and the disease has now spread across all 63 of the country's provinces. By the end of 2019, 5.8 million pigs across over 8,400 communes had died, accounting for 8.5% of the total pig population (DLP 2019). During 2020, ASF appeared again in many provinces, causing direct damage to the pig herd as well as an imbalance in pork demand-supply, leading to a sudden increase in the price of pork and pigs in the whole country (Source: Ministry of Agriculture and Rural Development (MARD) 2020).

Figure 1: Price of pigs in 1,000 Vietnamese Dong (VND)/kg live weight (LW) before and during ASF outbreaks in the northern, southern and central regions of Vietnam.



Source: Ministry of Agriculture and Rural Development (MARD) 2020.

This study was carried in Lào Cai Province in northwest Vietnam where ASF has affected pig production development. Pork accounts for over 78% of total meat output in Lào Cai, with the rest consisting of beef and poultry meat. The province has issued a plan to restructure the livestock sector in order to increase added value and drive sustainable development. This includes supporting the livestock sector to focus on biosecure production—efforts to reduce biological risk from diseases, pests or other factors. Understanding the risk factors along the pig value chains for ASF can help the province adopt appropriate solutions to manage and reduce the impact of the disease. The specific aims of this study include:

- To identify the risk factors that might contribute to the transmission and spread of ASF, including the risk factors related to swill feeding and transport of pigs;
- To assess what resources, knowledge and practices are required to prevent ASF transmission in the immediate future;
- To conduct an assessment on what is needed to build greater awareness, disseminate information and train different stakeholders in order to better prevent and manage ASF; and
- To provide recommendations on corrective measures needed in the short and long term.

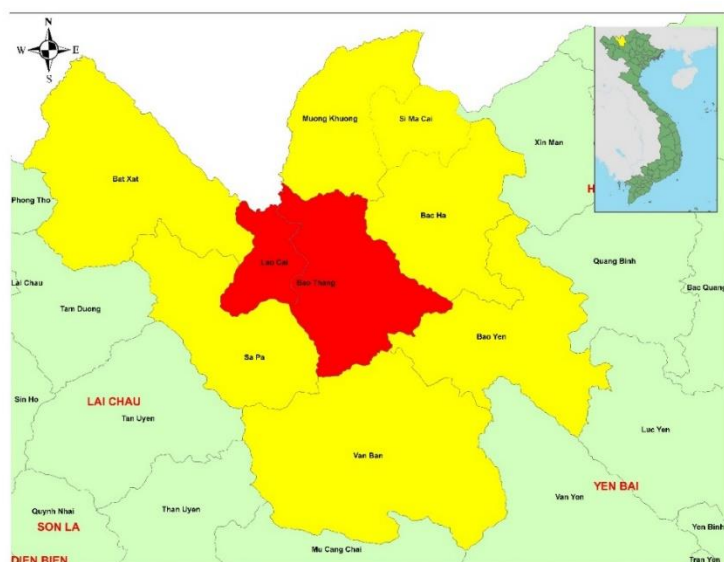
This study focuses on (i) the characterization of pig production and marketing systems; (ii) the identification of constraints and opportunities faced by producers; (iii) an assessment of disease magnitude in terms of loss of animals, markets and livelihoods for smallholder farmers, pig breeders and other stakeholders; and (iv) a brief assessment of the diagnostic and surveillance capacities of the Lào Cai provincial authorities to detect, prevent and control ASF, as well as to effectively address the emerging challenges of ASF.

Materials and methods

Study area

Lào Cai is a mountainous province in northwest Vietnam along the border with China (Figure 2). The area of the province is 6,384 km². The province has a dry and cold season from October to March and the tropical monsoon in the rainy season lasts from April to September. The annual average temperature is 23 °C and ranges from 18–28 °C in the province's mountainous region and from 20–22 °C in the lowlands. Fog and frost are common in the province.

Figure 2: Study area: Bảo Thắng District and Lào Cai city, Lào Cai Province.



Source: recent study. The population in 2019 was 730,420 people, 76.5% of them living in rural areas. More than 20 ethnic groups live in Lào Cai Province; the majority are ethnic Kinh people, accounting for 33.8%, and the other main ethnic groups include the H'Mong, Tay, Giao and Nung. Smaller ethnic groups include the Phu La, San Chay, Ha Nhi and La Chi. In 2015, 34.3% of households (53,605 households) were living beneath the poverty line¹ and this figure declined annually by about 4–5% from 2016 to 2020.

Agricultural, forestry and ecotourism are the main economic sectors in Lào Cai Province. Main crops include maize (38,243 ha), rice (33,856 ha), vegetables (15,000 ha), fruit trees (13,182 ha), tea (6,500 ha), medical herbs (2,300 ha) and other crops (11,209 ha) (Lào Cai DARD, 2019). Major livestock species include pigs, buffalo, cattle and poultry. Pigs are the main source of meat for domestic consumption, however, the pig population has been reduced due to ASF. Table 1 summarizes the numbers of livestock species in the province for the last three years, including for 2018, before first outbreak of ASF.

Table 1: Numbers of main livestock species in Lào Cai Province, 2018–2020

Livestock species	2018	2019	2020
Buffalo	133,000	129,000	122,587
Cattle	19,500	19,000	17,800
Pigs	518,000	475,000	375,647
Poultry	3,950,000	4,250,000	4,850,000

¹ The poor: income of 700,000 VND/person/month (USD 30.5) in rural areas and 900,000 VND/person/month (USD 39.1) in suburban areas. (Decision 59/2016-QĐ-TTg issued on 19/11/2015 by the prime minister for standardization of the poor 2016–2020).

Source: Reports of the Lào Cai Sub-Department of Animal Husbandry, Veterinary and Aquaculture (Sub- DAHVA) (2018, 2019 and 2020)

Bảo Thắng is a lowland district with an area of 652 km², a relatively large population of 103,262 people (in 2019) and a population density of 158 people per km². The district is located in the centre of Lào Cai, is accessible for transportation and is bordered by China and most other district-level administrative units in the province (except for the districts of Bat Xat and Si Ma Cai). The district is the gateway to the provincial capital, Lào Cai, and has many advantages for socio-economic development. The district capital is Pho Lu town, about 40 km southeast of Lào Cai city. The district sits along National Highway 70, Highway 4E, the Hà Nội-Lào Cai expressway and the Kunming-Hà Nội railway as well as the Red River.

Bảo Thắng is an important district in livestock production development for Lao Cai Province, especially pig and poultry production. From 2018–20, Bảo Thắng accounted for 25–36% of the total number of pigs in the province and over 40% of the total number of poultry (see Table 2). As Bảo Thắng is one of districts that saw high losses during ASF outbreaks in 2019 and 2020, this study draws interviews with pig producers in the district and with other key stakeholders in both Bảo Thắng (at the communal and district levels) and in Lào Cai city (at the provincial level).

Table 2: Numbers of main livestock species in Bảo Thắng District, 2018–2020

Livestock species	2018		2019		2020	
	Number	Share of province total	Number	Share of province total	Number	Share of province total
Buffalo	11,770	9%	11,786	9%	8,312	7%
Cattle	1,600	8%	1,520	8%	2,125	12%
Pigs	161,810	31%	120,500	25%	136,862	36%
Poultry	1,750,000	44%	1,852,000	44%	1,973,919	41%

Source: Reports of the Lào Cai Sub- DAHVA and Bảo Thắng Department of Agriculture and Rural Development (DARD) (2018; 2019; 2020)

Data collection

Data and information were collected through interviews with key people and pig producers using standardized questionnaires and through focus group discussions (FGDs) using open-ended questions. In addition, the initial findings were validated in a stakeholder feedback workshop. The number of interviews and FGDs and participant numbers are summarized in Table 3. Before the interviews, the interviewees signed a consent form after either reading it or listening to the text (Annex 1).

Table 3: Summary of interview and FGD participant numbers

Activities	Number of interviews or FGDs	Number of participants
Key person interviews	16	16
FGDs (including a training needs assessment)	5	33
Pig producer interviews	80	80

Key person interviews

Key person interviews were carried out with one provincial livestock officer, one district livestock officer and one communal vet. These focused on current pig production and marketing systems; changes following ASF outbreaks; impacts of ASF; and the capacities of local authorities for diagnosing, recognizing, monitoring and controlling ASF. They also included questions about the restocking of pig herds (See Annex 2 for questionnaire).

Researchers also conducted 10 key person interviews with stakeholders in the pig supply chain including collectors and slaughterers at the provincial, district and communal levels as well as retailers at the communal and village levels. These interviews focused on value chain mapping; ways of transporting pigs; current practices and changes caused by ASF; impacts of ASF; and any needs for training to cope with ASF (see annexes 3, 6 and 7).

Three key person interviews were carried out with pig breeders of different scales to gather information about pig breeding and production practices; the supply and transport of pigs; and changes before and during ASF outbreaks (Annex 5).

Focus group discussions

Two FGDs were held with farmers, each with a group of seven pig farmers of different production scales. These discussions gathered information and data on pig production and market systems; pig producers' contacts with other stakeholders in the value chain (using Venn mapping); transportation of pig inputs and outputs and constraints; and opportunities in pig production (via a SWOT assessment). Venn Diagram shows linkage of producers to other actors in the pig supply and consumption chain: Important direct relationships (bold / thin arrows), frequency of contact (write frequency along arrow), far, near distance (arrow length, inside, outside locality, province, district, commune); assessment of the risk potential of pathogen transmission through relationships (1. Danger, 2. No danger, 3. Don't know), and explain (Annex 9).

Two FGDs were carried out with pig producers, one with men and one with women, with 5–7 farmers per group. These discussions collected information for a training needs assessment to

understand the current situation, gaps and expectations regarding the resources, knowledge and practices required to prevent ASF transmission. Discussions also collected information on possible solutions to improve awareness and information dissemination (Annex 9).

One FGD was conducted with seven livestock officers, including vet workers and agricultural extension officers from the district and communal levels. This discussion was also a training needs assessment aimed at understanding the current situation, gaps and expectations regarding the resources, knowledge and practices required to prevent ASF transmission. It also covered solutions for improving awareness, disseminating information and meeting training needs as well as a brief assessment on the diagnostic and surveillance capacities in Lào Cai Province to detect, prevent and control ASF (Annex 8).

Pig producer interviews

In total, 82 individual pig producers were interviewed including 18 from commercial pig farms (4 from farms with cases of ASF and 14 from farms with no cases of ASF) and 64 from household farms² (28 from farms with cases of ASF and 36 from farms with no cases of ASF). These interviews focused on current practices; ways of transporting pigs; benefits from pig production; changes caused by ASF and the restocking of pig herds; and needs for training to cope with ASF (See Annex 4 for details of the questionnaire)

Stakeholder feedback workshop

This workshop was held on 13 January 2020 at the Bảo Thắng Agricultural Service Center with a range of stakeholders in order to validate initial field findings. There were 19 participants including officers of the Lào Cai Sub-DAHVA and the Bảo Thắng Agricultural Service Center, communal vet workers, pig cooperative representatives, pig keepers and pig traders as well as researchers from the National Institute of Animal Science (NIAS), the International Livestock Research Institute (ILRI) and the National Institute of Veterinary Research (NIVR) (Annex 10).

Data analysis

Qualitative data and information were described, summarised and analysed. Quantitative data were analysed in Excel for mean, standard deviation (SD) and percentages. Linear regressions were carried out for the distribution of pig producers with and without cases of ASF as well as for pig

² Household farm = <10 Livestock Units (LU; equal to 50 fatteners); small farm = 10–30 LU (50–150 fatteners); medium farm = 30–300 LU (150–1,500 fatteners); large farm ≥300 LU (≥1,500 fatteners), according to Decree No. 13/2020/ND-CP: Elaboration on the Law on Animal Husbandry (Government of Vietnam 2020; National Assembly 2018)).

producers who practice and do practice swill feeding, based on the number of biosecurity criteria each farm has adopted and the number they have not adopted.

$$Y_i = \alpha X_i + \beta + e_i$$

In which Y_i ; X_i is the i th observed value ($i = 1$ to n) where X_i of the independent variable and Y_i is the dependent terminal; α ; β is the regression coefficient where α is slope and $\beta = rS_x / S_y$ is the intercept, e_i : residual or errors coefficient.

Results and discussions

1. Pig production systems and the impacts of ASF outbreaks

1.1. Overview of pig production systems and impact of ASF in Bảo Thắng, Lào Cai Province

Among 93,977 livestock producers in Lào Cai Province, pig producers accounted for 76% (71,461 pig farms). Of these, the largest share are household farms and only about 0.3% are industrial commercial farms. There are nine industrial pig farms in Bảo Thắng and Bac Ha districts that have adopted advanced technology, including two breeding farms (one with 150 breeding sows and one with 700) and seven fattening farms (with roughly 300, 1,000 or 2,000 fatteners on each farm). Table 4 summarizes the current pig herd structure of Lào Cai Province.

An ASF outbreak occurred in Lào Cai Province from 17 May 2019 to 23 February 2020 and occurred again on 1 May 2020. In the epidemic in 2019, ASF was found on 6,575 pig farms (accounting for 9.23% of the whole province's pig producers) of which 23 were commercial farms and the rest were household farms. The 2019 outbreak was found on farms in 766 villages in 125 out of the province's 164 communes, wards and towns across all nine of the province's districts and cities. In total, 36,510 pigs died of ASF including 6,806 sows and boars and 29,704 fatteners and piglets. All pigs in the same herds as the sick pigs had to be killed. An estimated 7.6% of the district's total herd was killed with an estimated weight of 1,623,213 kg.

In 2020, cases of ASF occurred in 7 out of Lào Cai's 9 districts, towns and cities (Van Ban, Muong Khuong, Bat Xat, Bao Yen, Si Ma Cai, Lào Cai city and Sa Pa town), affecting the pigs of 976 household farms in 232 villages of 63 communes and towns; 3,530 infected pigs were killed (833 sows and boars; 2,697 fatteners and piglets), with a weight of 173,763 kg. The diseased pigs belonged mainly to small household farms that applied few or no biosecurity breeding practices. During and after the ASF outbreaks, the expenditure for disinfection highly increased.

Table 4: Current pig herd in Lào Cai Province

Type of pig	Current (2020)	
-------------	----------------	--

	Total population	Local breed (%)	Crossbreed (%)	Exotic (%)	Percentage of total 2018 population
Total pig herd	375,647				72.5%
Total sows	37,429	77.4	17.6	4.9	54.5%
Total piglets	54,809				
Total breeding boars	2,942	89.4	10.6		94.6%
Fatteners	280,467	50.6	49.4		61.9%

Note: GGP = great grandparent; GP: grandparent

Source: Key person interviews (2020)

Table 5 summarizes the number of different types of pig farms in Bảo Thắng District. In general, household farms are distributed across all communes, while commercial farms and breeding farms are mainly concentrated in certain communes such as Xuan Phu, Phu Nhuan, Phong Hai, Xuan Giao, Xuan Quang and Son Ha communes. The number of pig producers in 2020 decreased compared to 2018, especially the numbers of commercial farms and farms with boar service.

Table 5: Major pig farm types and distribution in Bảo Thắng District, 2020

Type of pig farm	Number	Major location distribution	Change compared to 2018
Breeding farms	8 (1 GP)	Xuan Phu, Phu Nhuan, Phong Hai, Xuan Giao, Xuan Quang and Son Ha communes	No change
Boar keepers for natural mating service	13	All communes	Strong decrease
Boar keepers for AI service	18	All communes	Decrease
Commercial farms	87	Phong Hai, Xuan Giao, Xuan Quang communes	Decrease
Household farms	3,839	All communes	Decrease
Pig Cooperative	1	Son Ha commune	No change

Note: AI: artificial insemination

Source: FGD with district officers (2020)

Though Bảo Thắng District accounts for 36% of total pigs in the province, these are mainly crossbreeds and exotic pigs; only 22.4% of the district's sows are local sows. After ASF, the number of breeding boars, particularly boars for natural mating services, strongly decreased (Table 6).

Table 6: Pig herd structure and numbers in Bảo Thắng District

Type of pig	Current	Change compared to 2018
--------------------	----------------	--------------------------------

	Number	Local breed (%)	Crossbreed (%)	Exotic (%)	
Total pigs	136,862	9.1	90.9		Decrease
Sows	5,503	22.4	50.7	26.9	Decrease
Total piglets	11,830				
Total boars	61				Decrease by 30 – 40% compared to 2018
- Boars for AI	47				
- Boars for natural mating service	14				Local boars decreased from 73 to 4
Fatteners	119,468				

Source: Key person interviews (2020), reports of Bảo Thắng DARD (2018, 2020)

ASF occurred in Bảo Thắng District from 21 May to 18 October 2019 in 653 household farms across 135 villages in all 15 communes and towns in the district. The outbreak caused the deaths of 5,974 pigs (total loss of 302,210 kg) including 778 sows, 34 boars and 5,162 fatteners and piglets. No cases of ASF have been reported in the district in 2020 but there have been cases in the neighbouring districts of Van Bao, Bao Yen and Muong Khuong. However, farmers may consider any case of several pigs dying or getting sick on a single farm to be ASF, which may result in over reporting in some areas. The decrease in pig herd size when doing restocking is also related to that farmers being afraid of the ASF epidemic, high cost of breeding pigs after ASF outbreaks. The impact of ASF is considered more serious for small and medium-sized commercial farms as it is difficult for them to recover as in bad debt. They got disease earlier than larger farms.

The large farms, even if they had pigs that were sick in 2020 (they do not sure with ASF or other diseases), they already benefited from sales of pigs at high prices after the ASF outbreak in 2019. Before the epidemic there were 50 large farms; now there are 4 large farms because many farms have reduced the scale of raising. Large farms with CP funds recover faster. Large farms did not get ASF in 2019, they could sell high-priced pigs in 2019, compensating for the lost in beginning 2020. For household farms (mixed farms), All most of them got ASF in 2019, some of them saw a very high percentage of their pigs die due to ASF but as these families still have other sources of income, like sales of crops, their risk seems to be lower than that of small and medium-sized commercial pig farms (Table 7).

Table 7: Impact of ASF on livelihoods of pig producers as evaluated by vet, livestock officers and agricultural extension workers

Pig farm type	Percentage with cases of ASF	Percentage of total pigs infected with ASF	Level of impact on farmers' livelihoods (1=low; 5=high)
Large farms	20	10	1
Medium farms	40	20	4
Small farms	45	25	3
Household farms	50	70–90	2

Source: FGDs with livestock officers (2020)

1.2. Pig production of interviewed farmers in Bảo Thắng District

Among interviewed pig producers, the heads of both household farms and commercial farms had an average age of about 50 years old with about 20 years of experience keeping pigs. The interviewees' households had an average of 4-5 family members, around 3 of them being labourers and around 2 of these family labourers being involved in pig production (see Table 8).

Table 8: Demographic information about interviewed pig producers

	All farms (n=82)		Household farms (n=64)		Commercial farms (n=18)	
Criteria	Mean	SD	Mean	SD	Mean	SD
Age of household head (years)	49.37	10.74	48.63	10.86	52.00	10.13
Years raising pigs	20.90	10.68	20.95	10.71	20.72	10.89
Number of family members	4.39	1.54	4.34	1.49	4.56	1.72
Number of family members who are labourers	3.04	1.14	3.05	1.12	3.00	1.24
Number of family labourers involved in pig production	1.84	0.58	1.88	0.58	1.72	0.57

Source: Pig producer interviews (2020)

On average, a household in 2020 kept 3 sows and/or 20 fatteners, while a commercial farm kept 11 sows and/or about 95 fatteners. These figures are much lower compared to 2018 (5 sows and/or 47 fatteners among household farms; 15 sows and/or 150 fatteners among commercial farms). It seems that the production scale of household farms decreased more than that of commercial farms after the ASF outbreaks (Table 9).

Table 9: Structure of pig herds in 2018 (before ASF outbreak) and 2020 by farm type

	Household farms			Commercial farms		
	n	Mean	SD	n	Mean	SD
Gilts						
2020	7.0	3.3	1.1	2	22.5	24.8
2018	-	-	-	1	20.0	-
Sows						
2020	41.0	3.2	2.1	16	11.0	9.9
2018	55.0	5.2	7.5	18	15.3	22.3
Piglets						
2020	7.0	10.1	7.9	9	28.0	22.0
2018	15.0	23.8	26.3	7	38.7	30.1
Fatteners						
2020	47.0	20.1	12.8	16	94.7	59.7
2018	59.0	46.9	67.0	18	150.2	105.6

Source: Pig producer interviews (2020)

Tables 10 and 11 show the estimated production costs of piglet litters and of fatteners, as reported by the interviewed pig producers, for before (2018) and after the ASF outbreaks (2020). Production costs for commercial farms are a bit higher than for household farms, however, the opportunity costs of family labour are not included in the calculation. Compared to 2018, production costs increased by about 100,000 VND per litter for both household and commercial farms. This may come from an increase in adoption of biosecurity measures on farms. After the ASF outbreaks, most of the interviewed farmers did not sell breeding piglets as they kept all of them for restocking their own pig herds. Therefore, the benefit from producing piglets was not considered.

Table 10: Production cost of breeding a piglet litter currently and before ASF outbreak (year 2018), by farm type

	Household farms			Commercial farm		
	n	Mean	SD	n	Mean	SD
2020	41	4,386.7	1,380.0	16	4,749.6	1,074.6
2018	48	4,266.1	1,218.7	17	4,649.5	914.6

Note: Production cost (Mean in 1000 VND); a litter comprises of 10–11 weaned piglets

Source: Pig producer interviews (2020)

Similar to the production of breeding piglets, the average production cost for fatteners was higher for commercial farms than for household farms. In 2020, the cost per fattener was 1 million VND higher for commercial farms and 700,000 VND higher for household farms than in 2018. Nevertheless, as the price of pigs and pork increased in 2020 compared to 2018, the benefit per fattener was much higher, increasing from about 700,000 VND to almost 4 million VND for household farms and from around 900,000 VND to 4.2 million VND for commercial farms (Table 11).

Table 11: Costs and profits of a fattener by farm type

	Household farms			Commercial farms		
	n	Mean	SD	n	Mean	SD
Time of raising (days)						
2020	46	160.2	13.7	16	164.1	13.7
2018	56	163.4	18.6	17	166.8	16.8
Weight at slaughter (kg)						
2020	46	114.6	13.0	16	120.6	12.2
2018	56	112.5	14.5	17	117.1	14.9
Production cost (1,000 VND)						
2020	48	4,424.2	1,481.5	16	4,760.5	1,165.2
2018	56	3,704.5	932.0	17	3,788.4	921.2
Unit price (1,000 VND/kg Live Weight (LW))						
2020	46	76.6	6.0	16	74.6	6.6

2018	56	39.0	9.1	17	40.2	4.0
Pig value (1,000 VND/pig)						
2020	46	8,766.6	1,175.6	16	8,973.1	1,049.8
2018	56	5,283.8	6,751.5	17	4,714.7	752.7
Profit/pig						
2020	48	3,977.2	2,015.2	16	4,212.6	1,559.9
2018	55	724.3	1,059.0	17	926.4	583.8
Profit/farm						
2020	33	169,275.7	230,143.1	11	631,865.7	258,731.8
2018	42	83,702.8	315,860.3	12	205,004.5	162,646.5

Source: Pig producer interviews (2020)

Among interviewed farms who had pigs that were infected with ASF, on average, about 6 sows and more than 40 fatteners died on each farm, for both household and commercial farms (Table 12). Only farms that were seriously affected by pigs dying from ASF informed vet workers in order to obtain a government subsidy for each pig slaughtered due to ASF.

Table 12: Pig losses caused by ASF among the farms having pigs infected with ASF, by farm type

		Household farms			Commercial farm		
	Unit	n	Mean	SD	n	Mean	SD
Sows killed	pigs	17.0	5.8	6.8	2	6.5	5.0
Value of sows killed	million VND	7.0	29.4	18.7	2	55.0	35.4
Subsidy for sows killed	million VND	3.0	29.3	17.2	1	10.0	-
Fatteners killed	pigs	18.0	43.1	60.8	3	42.0	51.2
Value of fatteners killed	million VND	8.0	71.9	52.0	3	163.3	150.4
Subsidy for fatteners killed	million VND	4.0	14.1	11.0	1	8.0	-

Source: Pig producer interviews (2020)

In addition, the information from the interviews, we found that 30% of household farms and 44.5% of commercial farms said that they sold all pigs when their farm or surrounding farms discovered cases of ASF or having some sick pigs.

In 2020 as compared to 2018, household farms in Bảo Thắng District sold around 50% fewer pigs while commercial farms sold only 17% fewer pigs (Table 13). The data suggests that commercial farms have a greater capacity to restock than household farms during the current situation of ASF.

Table 13: Changes in pig output (slaughtered pigs) from 2018 to 2020 by farm type

		Households	Commercial farms
--	--	------------	------------------

	Unit	n	Mean	SD	n	Mean	SD
2020							
Number of pigs sold	pigs	33.0	38.0	38.3	11.0	147.9	53.6
Weight per pig when sold	kg	46.0	114.7	13.9	17.0	121.5	9.1
2018							
Number of pigs sold	pigs	43.0	76.9	116.1	12.0	178.2	110.0
Weight per pig when sold	kg	55.0	108.0	19.7	18.0	116.7	14.1

Source: Pig producer interviews (2020)

Among farms that had cases of ASF, the number of pigs sold decreased by an even larger percentage, dropping 58% in 2020 compared to 2018. Farms without cases of ASF saw only a slight decrease (

Table 14). This demonstrates that ASF impacted farms not only through the loss of pigs at the time of the outbreaks but also by slowing the restocking rate of the farms.

Table 14: Changes in pig output (slaughtered pigs) from 2018 to 2020 by presence of ASF cases

		Farms with cases of ASF			Farms without cases of ASF		
	Unit	n	Mean	SD	n	Mean	SD
2020							
Number of pigs sold	pigs	13.0	44.9	69.7	31.0	74.1	60.3
Weight per pig when sold	kg	21.0	111.3	17.5	42.0	119.2	9.4
2018							
Number of pigs sold	pigs	20.0	117.7	182.3	35.0	88.3	67.3
Weight per pig when sold	kg	28.0	108.1	23.1	45.0	111.4	15.6

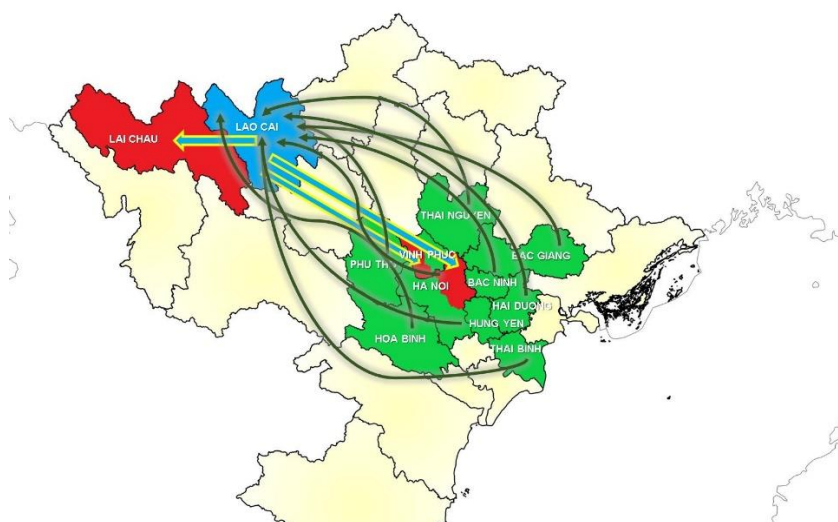
Source: Pig producer interviews (2020)

2. Pig market systems and the impacts of ASF outbreaks

2.1. General information on pig market systems in Lào Cai Province and Bảo Thắng District

In Lào Cai Province, about 70–80% of pigs are supplied by breeders and producers within the province and the rest are imported from other provinces such as Vĩnh Phúc, Phú Thọ, Hà Nội, Hòa Bình, Thái Nguyên, Hải Dương, Hưng Yên, Thái Bình, Bắc Giang and Bắc Ninh. Output of pig production in the province in 2020 (44,000 tonnes) showed a decrease compared to 2018 (50,450 tonnes) but a slight increase compared to 2019 (42,287 tonnes) . About 40,000 tonnes of LW pigs are consumed within the province and the rest are exported, mainly to Hà Nội, Vĩnh Phúc and Lai Châu.

Figure 3: Live pig movement in and out of Lào Cai Province.



Source: current study

Within Bảo Thắng District, about 50–60 % of pigs are supplied by producers and breeders within the district and the rest are imported, mainly from Hà Nội and farms in the lowland provinces. Pig productivity in the district has decreased compared since the outbreaks of ASF, from 22,603 tonnes in 2018, to 19,280 tonnes in 2019 and 20,940 tonnes in 2020. All pigs from Bảo Thắng are consumed within Lào Cai Province. About 70% of total pig yield is consumed within the district and the rest is consumed in Bắc Hà, Mường Khương and Sa Pa districts.

The demand for pork in 2020 has decreased sharply compared to the previous years as consumers tended to increase consumption of poultry, beef and fish, mainly due to the high price of pork. Since the end of 2019, the market price of pork has increased up to 95,000 VND/kg. From the beginning of 2020 until now, the pig price ranges from 80,000-92,000 VND/kg. At the moment, the price of live pigs is about 72,000–75,000 VND/kg.

2.2. Major pig market systems and ASF impacts

The major pig market systems in the study area were identified based on stakeholder interviews.

Collector-slaughterers at the provincial level

Across the province, there are two current major systems in which collector-slaughterers play different roles: one in which they sell to whole sale markets and one in which they sell primarily to restaurants and retailers (

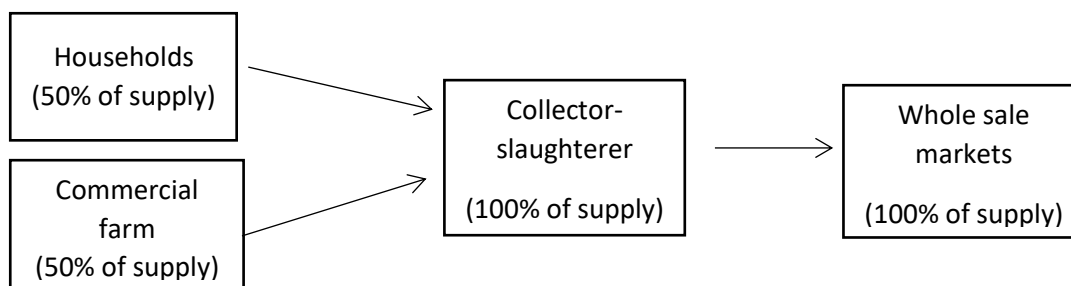
).

System 1: The collector-slaughterer collects pigs from both household and commercial farms in the province, collecting an average of six tonnes LW per month and selling an average of four tonnes of pork directly to whole sale markets. Before the ASF outbreaks, the collector-slaughterer could collect 10 tonnes LW per month, slaughter the pigs and then sell an average of 7 tonnes of pork per month. The percentages are not much changed during the ASF.

System 2: The collector-slaughterer collects currently about 10 tonnes LW per month from pig producers within the province, slaughters all the pigs and sells mainly to retailers (55%) and restaurants (40%), selling only 5% as a direct independent retailer. In 2018, they could collect an average of 16.5 tonnes LW per month. During the ASF outbreaks, it was difficult for the collector-slaughterer to buy pigs within the province and about 20% of total pigs consumed within Lào Cai Province were purchased from other provinces such as Yen Bai, Hung Yen and Bac Giang. Currently, the collector-slaughterer needs to pay a fee for quarantine when buying pigs from other provinces, incurring an increased costs of 12 million VND per month. During the ASF outbreaks, the demand from restaurants and consumers also dropped. The collector-slaughterer adapted by buying pigs from intermediaries for a fee and selling 35% of their total pork as a retailer at the market. Sometimes groups of collectors collaborated to buy pigs from CP or Dabaco farms.

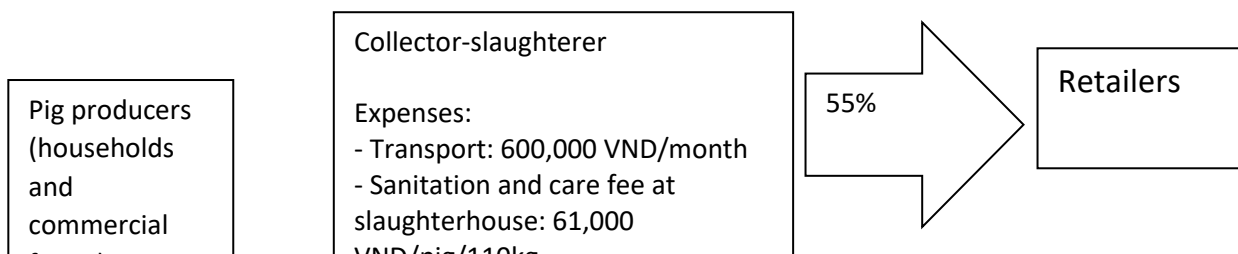
Figure 4: Major current provincial pig market systems involving collector-slaughterers and changes following ASF outbreaks.

System 1:



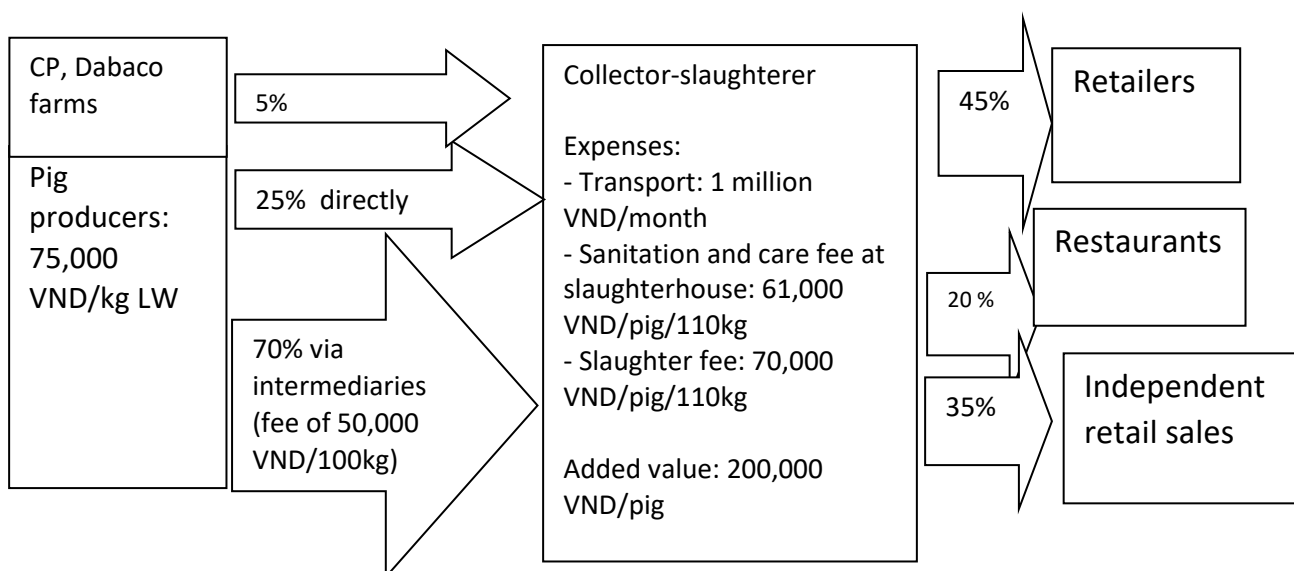
The percentages are not much changed during the ASF

System 2:





Change during time with ASF in the region of system 2:



Source: Key person interviews (2020)

Slaughterhouse concentration at the provincial level

A slaughterhouse was built in Lào Cai city with a capacity of 250 pigs per day and equipped with a hanging system. However, this system is not running and pigs are manually slaughtered. As a result, the current capacity is an average of 60 pigs per day, a decrease from the capacity in 2018 (80 pigs per day) and 3–4 years ago (150–200 pigs per day). Pigs are sourced within the province and come mainly from household farms (80%) and commercial farms (20%). Live pigs are transported to the slaughterhouse mainly by truck and pork is transported to retailers (85%) and restaurants (15%) primarily by motorbike. Veterinarians implement quarantine practices in the slaughterhouse and provide certification stamps for slaughtered pigs as safe food.

Slaughterhouse concentration at the district level

A new slaughterhouse was built in Bảo Thắng District in October 2020 with a capacity of 35–40 pigs per day by manual slaughter. As at the slaughterhouse in Lào Cai city, pigs are mainly sourced from household farms (80%) and commercial farms (20%). Live pigs are transported to the slaughter house mainly by truck and pork (carcasses) is transported by both truck and motorbike to retailers (70%) and restaurants (30%) in the district.

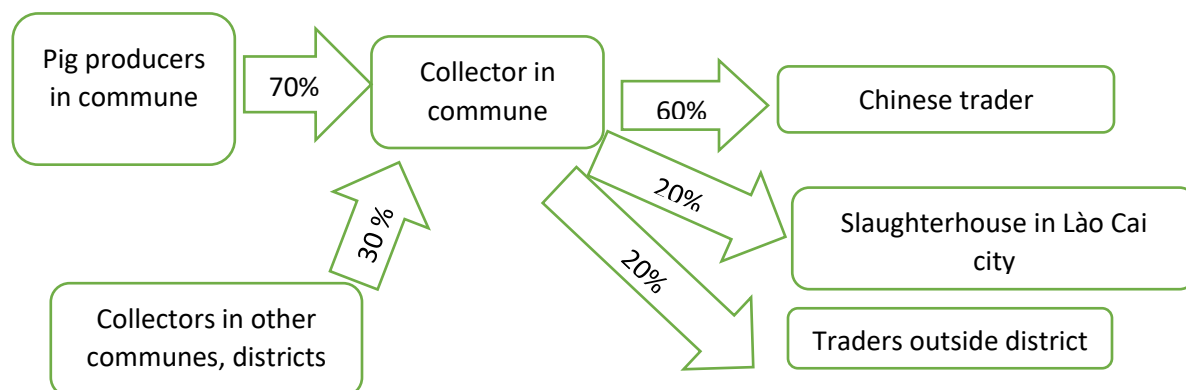
Collectors in Xuan Quang commune

In Xuân Quang commune, Bảo Thắng District, there is a collector collecting pigs for trading with traders from China and other districts (

Source: Key person interviews (2020)

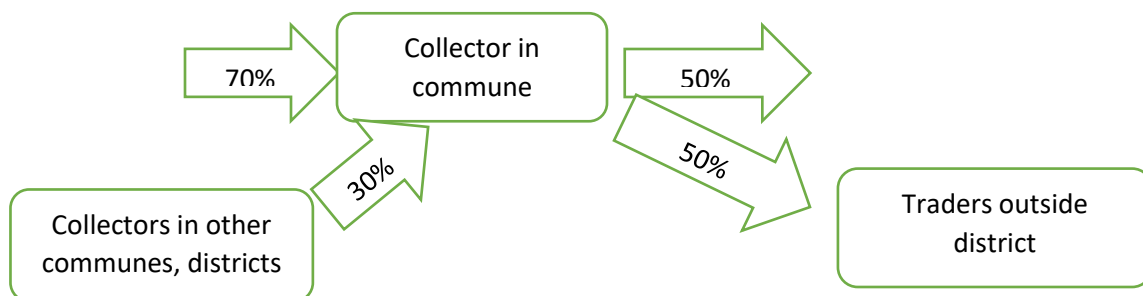
). They mainly collect pigs from the commune (70%) and sell them to Chinese traders via an intermediary (60%). They sell the rest to traders outside the district or to the slaughterhouse in Lào Cai city. Since the ASF outbreaks, pigs are no longer sold to Chinese traders. A quarantine certificate is required to transport pigs into China. Collecting pigs for Chinese traders can provide significant income (5,000–6,000 VND/kg LW), compared to selling to traders in Việt Nam (500,000 VND/tonne LW) or to slaughterhouses (3,000 VND/kg LW). Collecting pigs via sub-collectors additional cost is 500–1,000 VND per 1 kg LW and transporting pigs to China costs 1 million VND/tonne.

Figure 5: Market system involved by a pig collector in Xuan Quang Commune, Bảo Thắng District
Current system:



Changes when ASF outbreak in the region





Source: Key person interviews (2020)

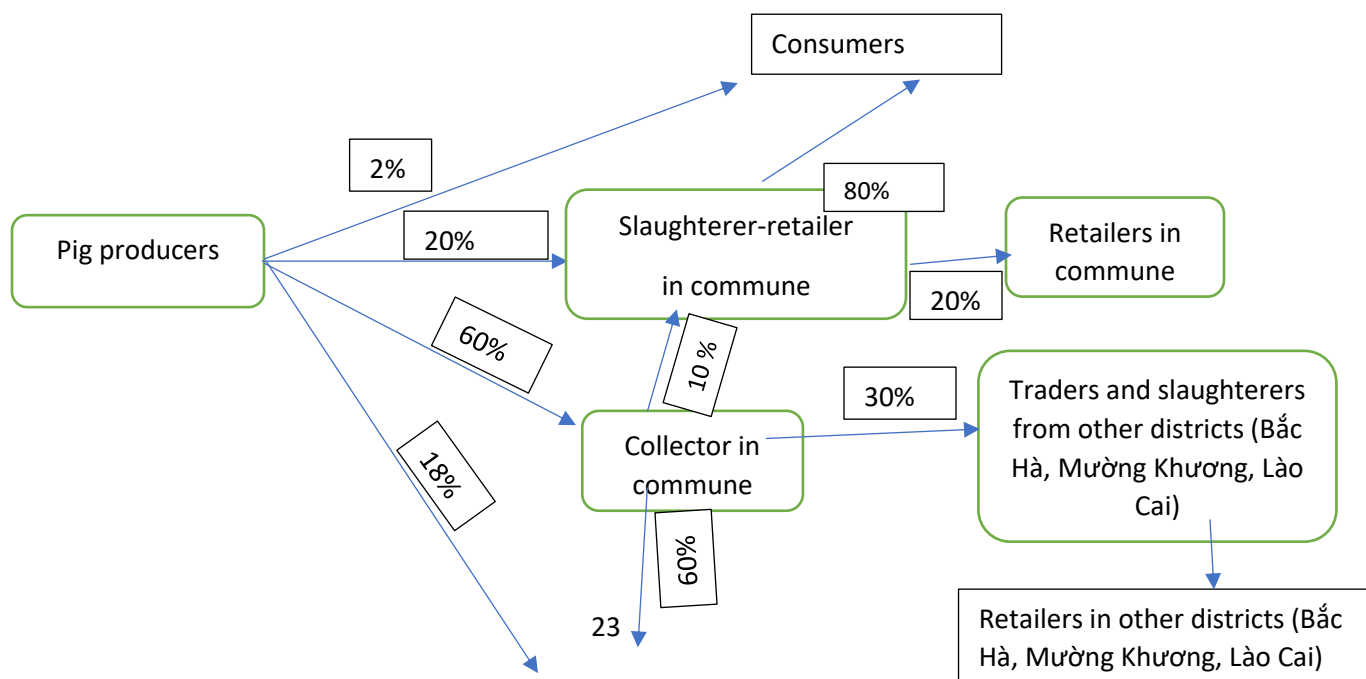
Retailer concurrent collector, (slaughterer) at communal level

Pig retailers in the commune source pigs from household farms themselves and slaughter pigs at home or at slaughter points for a fee. They transport pigs and pork by motorbike and sell in communal markets. During the ASF outbreaks, about 10–20% of retailers in the district stopped doing business due to difficulties in sourcing pigs as there were fewer pigs, prices for pigs were higher and many people reduced their consumption of pork.

Pig producers in Xuan Quang commune

There is no difference in market systems between household and commercial farms in the commune. All farmers sell pigs mainly to collectors in the commune (60%), with the rest going to collector-slaughterer-retailers in the commune (20%) and local intermediaries (18%). Figure 6 shows that pigs sometimes go from producers through several nodes of intermediaries, collectors or slaughterers before being sold to consumers.

Figure 6: Major market system involving interviewed producers in Xuan Quang commune



Slaughterer in
Lào Cai city

Source: Pig producer FGD (2020)

3. Assessment of risk factors in transmission of ASF along the major pig value chains

3.1. Assessment of reasons for the transmission of ASF as assessed by local authorities

ASF was initially spread in 2019 for a number of key reasons: people bought, sold and transported pigs and pork infected with pathogens; used leftover pork from restaurants; and bought feed from household farms where pigs had contracted ASF. The epidemic then spread rapidly and widely due to the following factors:

- (1) uncontrolled slaughter points in residential areas;
- (2) farmers' use of swills from restaurants and kitchens as pig feed;
- (3) keeping of livestock close to family kitchens;
- (4) people moving from households where pigs had ASF to other households;
- (5) the officials' non-compliance with anti-epidemic regulations (for example, failing to examine, take samples from and kill diseased pigs);
- (6) direct spread through natural mating service or trading of pig semen;
- (7) the discarding of dead pig carcasses into the environment;
- (8) small households' low adoption of biosecurity practices; and
- (9) announcement of ending ASF outbreak of some commune, it may cause subjective psychology in disease prevention of some livestock farmers and local authorities.

In 2020, in addition to the above reasons, a number of new issues contributed to the spread of ASF. First, pig producers killed infected pigs near roads or water sources in contravention of technical procedures by not wearing biologically protective clothing and burying pigs through middlemen. Second, producers only destroyed infected pigs but not pigs in the same cage, causing diseases to spread and prolonging the outbreak. Third, the official mechanisms participating in disease prevention and control at the district and communal levels were sometimes inconsistent and erratic. Lastly, some pig producers did not report cases of ASF on their farm to officials or delayed their reports, allowing the epidemic to spread widely and making it difficult to control.

3.2. Adoption of animal health care and biosecurity practices in pig production

Among 82 main biosecurity practices suggested by the Food and Agriculture Organization (FAO) and the DLP (see Annex 4), interviewed commercial farms have fully adopted around 37 practices and partly adopted 10, on average, as of 2020. Household farms have fully adopted an average of around 25 practices and partially adopted an average of 11 practices. The number of biosecurity practices adopted increased sharply for both farm types in 2020 compared to 2018 (Table 15: Number of biosecurity practices applied by pig producers in Bảo Thắng District). After the ASF outbreaks, pig producers may have seen the importance of adopting biosecurity measures for their farms to reduce the risk of disease.

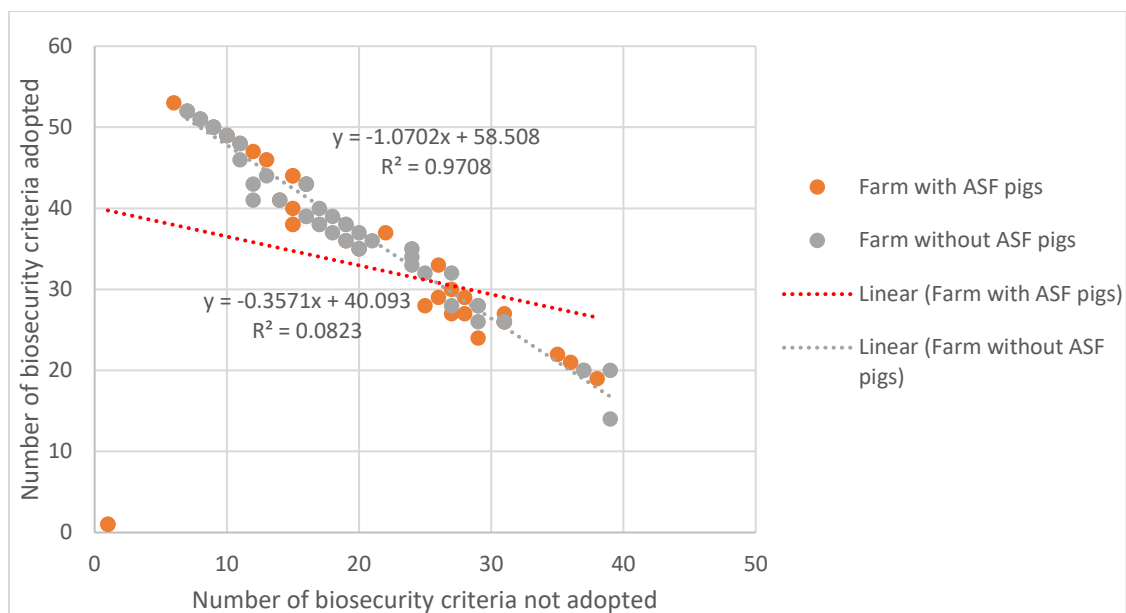
Table 15: Number of biosecurity practices applied by pig producers in Bảo Thắng District

	All			Household farms			Commercial farms		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
Number of biosecurity practices fully adopted									
2020	81	27.3	11.1	63	24.7	8.7	18	36.7	13.6
2018	79	9.3	5.2	63	9.7	5.3	16	7.9	4.7
Number of biosecurity practices partly adopted									
2020	74	10.4	5.5	60	10.5	5.4	14	9.9	6.0
2018	79	9.3	5.2	63	9.7	5.3	16	7.9	4.7
Number of FAO-DLP biosecurity practices not adopted									
2020	82	19.3	9.3	64	20.7	9.3	18	14.3	8.0
2018	82	22.5	9.0	64	23.7	8.6	18	18.2	9.2

Source: Pig producer interviews (2020)

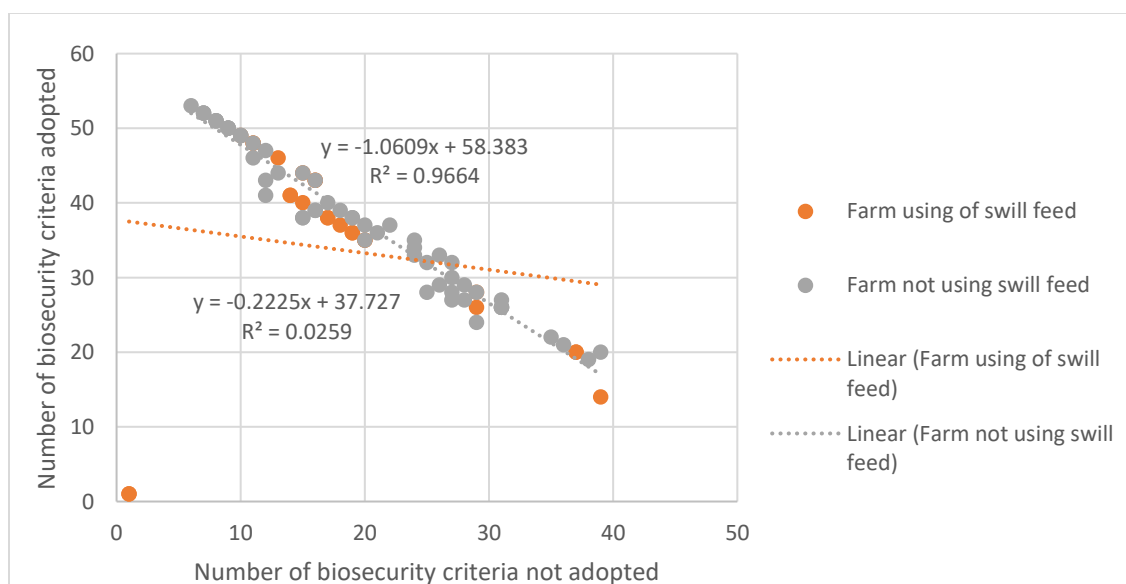
Linear regression shows a high positive correlation between the number of biosecurity practices adopted by a farm and whether that farm was free of ASF pigs. The farms where no pigs had ASF tended to adopt more biosecurity practices and farms that had pigs with ASF adopted fewer (Figure 7). It also can be seen that farms using swill feeds tended to adopt fewer biosecurity practices than those that were not using swill feeds.

Figure 7: Distribution of pig farms with and without cases of ASF over the number of biosecurity practices adopted.



Source: Pig producer interviews (2020)

Figure 8: Distribution of pig farms using and not using swill feeds over the number of biosecurity practices adopted.



Source: Pig producer interviews (2020)

Use of vaccines is higher among commercial farms than among household farms for all diseases (see Table 17). The commercial farms have applied better animal health care and adopted more

biosecurity practices than the household farms; this may partly explain the low risk of disease in general and of ASF in particular among the commercial farms in the study area.

Table 16: Percentage of farms vaccinating their pigs against disease.

	Household farms (n= 64)	Commercial farms (n=18)
Use of vaccination	98.4	100.00
Foot-and-mouth disease (FMD)	43.8	72.2
Porcine Reproductive and Respiratory Syndrome (PRRS)	65.6	94.4
Classical swine fever	92.2	100
<i>Salmonella choleraesuis</i>	67.2	88.9
Pasteurellosis	81.3	100
Leptospirosis	57.8	77.8
CIRCO	15.6	50.0
Mycoplasma	56.3	83.3
<i>Actinobacillus pleuropneumonia</i> (APP)	31.3	50.0
Porcine Epidemic Diarrhoea (PED)	15.6	50.0
Porcine Herpesviridae	14.1	38.9
Parvo	23.4	44.4

Source: Pig producer interviews (2020)

Selling pigs when the farm has diseased pigs or when a disease is spreading in the area is quite common for both household and commercial farms in the study area. Pigs are transported by car or motorbike; the use of motorbikes is more frequent among household farms. One third of interviewed household farms feed pigs using swill (Table 17), mainly cooked.

Table 17: Rates of some biosecurity practices among interviewed pig producers

Criteria	Households (%)	Commercial farms (%)
Selling of pigs when ASF is occurring on the farm or in the region	30.0	45.5
Transporting pigs to the farm by motorbike	76.1	28.6
Transporting pigs away from the farm	28.1	11.1
Use of swills as feed for pigs	37.5	0

Source: Pig producer interviews (2020)

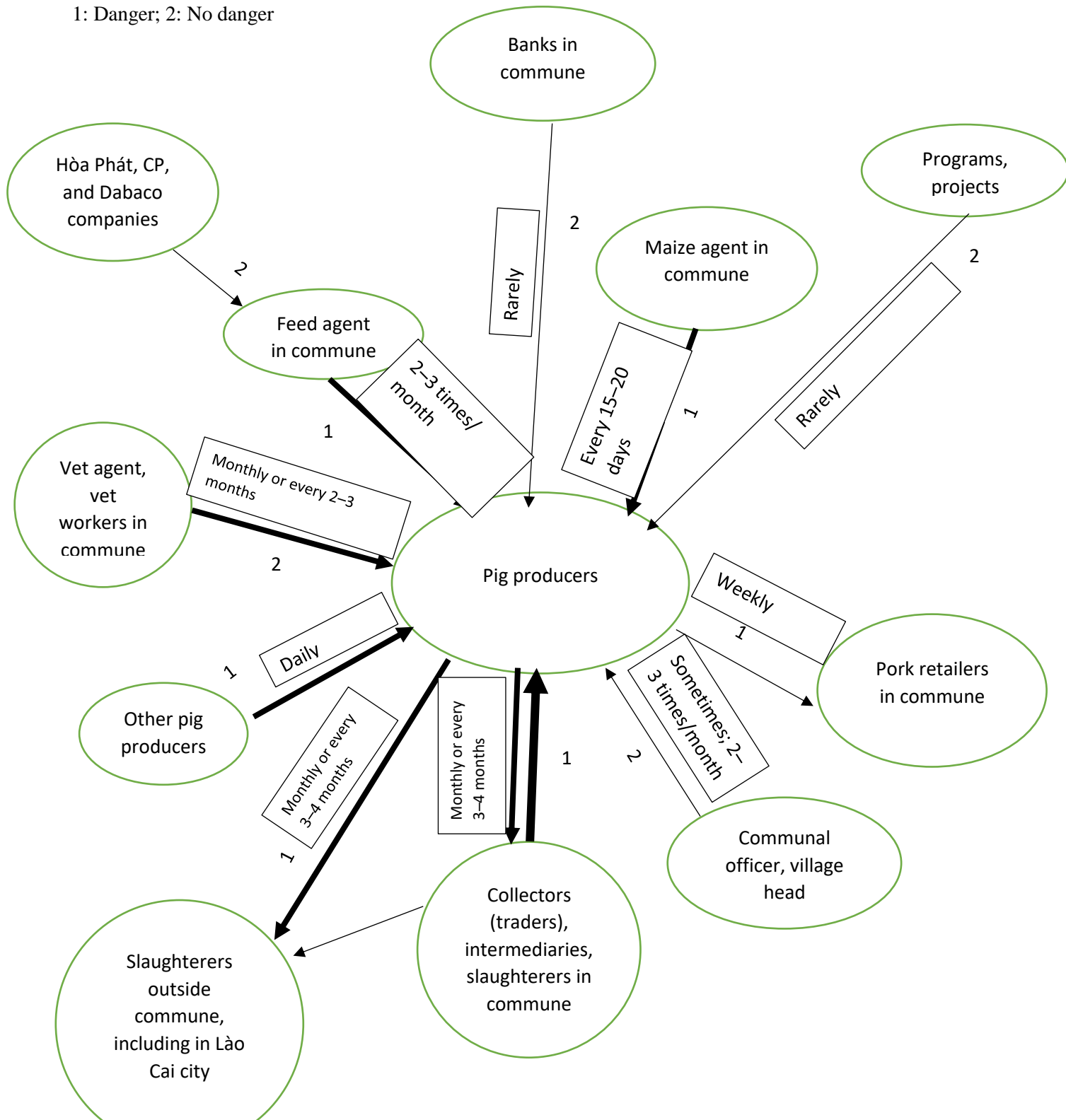
3.3. Perception of risk factors along the pig supply chain among pig producers in the study area

Source: Pig producer FGD (2020)

summarizes how pig farmers in the region evaluate the danger of ASF transmission from different actors in the pig supply chain through close contact and visits to pig farms. Farmers said that the highest risk of ASF transmission may come from collectors and slaughterers; intermediaries inside and outside the commune; feed agents and maize agents in the commune; and pig retailers.

Figure 9: Perceptions of danger of ASF transmission in the value chain among pig producers in the study area.

1: Danger; 2: No danger



Source: Pig producer FGD (2020)

Traders and slaughterers in the commune

Traders buy pigs from farmers and also sell them breeding piglets. Most households buy breeding piglets from traders and do not know the origin of the pigs. In addition, traders go many places, from household to household, and farmers therefore perceive them as having the highest risk of spreading disease. The slaughterers in the commune also go to multiple farms and to different places to buy pigs; they also have to go into pig stables to catch pigs. Farmers therefore perceive them as also having a high risk of spreading disease pathogens.

Slaughterers outside the commune and in Lào Cai city

Pig producers also consider these actors to have a high danger of spreading pathogens. They collect pigs from many places, including diseased regions, and also enter stables to catch pigs. Those from Lào Cai city often have contact with communal intermediaries to find pigs.

Intermediaries in the commune

Farmers may call these intermediaries when they want to sell pigs. The farmers who sell breeding piglets may sell them every month and those who sell fatteners may sell every 3–4 months. An intermediary is often also a trader or collector in the commune and travels to many regions to find and catch pigs. Villagers can sell pigs directly to the intermediaries, who then they sell to traders or slaughterers in Lào Cai city. In some cases, intermediaries will recommend to traders or slaughterers that they to come to the farms and buy the pigs. Because of these factors, farmers perceive communal intermediaries as having high risk of spreading ASF or other diseases.

Feed agents in the commune

These agents provide feed and possibly also breeding pigs to farmers. They come into contact with many farmers, including those with sick pigs. Farmers said the agents may spread disease but that the risk is not as high as with traders because agents do not enter the pigpens, except when they provide breeding pigs.

Pig retailers

Retailers are perceived by farmers as having a high risk of transmitting pathogens because they may sell pork from diseased pigs.

Maize agents in the commune

Farmers said that these agents have a level of risk similar to feed agents but that they present less risk because they do not provide breeding pigs to farmers and do not enter the pig stables.

Other pig producers

Farmers consider other producers to be high-risk actors as they go to many places, however, they rarely enter the pig stables of other farmers.

During the stakeholder feedback workshop, participants also discussed the risk factors for ASF transmission, especially the differences in risk level between commercial farms and household farms. Although the risk of disease on any farm is tied to many factors, workshop participants said that the human factors are lower on commercial farms because most of them apply biosecurity procedures, sterilize regularly and disinfect people entering and leaving the farm. On commercial farms, they also do not allow people, including traders, into the barn area. For small-scale producers, the human factor is one of the most important because they apply fewer biosecurity practices and do not control their neighbours or traders who may move in and out of the production area. Details from the workshop on the risk factors from different actors for commercials and households farms are summarized in Table 18.

Table 18: Risks to the farms come from different actors

Actors	Commercial farms	Household farms
Feed agents	The feed supplier is a risk for commercial farms but at low level. Feed is obtained directly from companies, not from other households.	The feed transport process presents a high risk of disease spread. The feed provider transports bran from one household to another. In addition, the bran dealers often sell to households but don't get paid until pigs are sold; households who have pigs that die, including from disease, may return the bran to the agent and the agent may then resell it to other households, thus causing serious spread of disease.

Veterinary staff, vet shops	Veterinarians or pharmaceutical dealers in the area are less likely to spread disease because commercial farms often use their own veterinary techniques and do not need to call veterinarians for treatment, minimizing the spread of pathogens from other farms.	Vet shops and local vet workers are also a risk factor because most people, from both family farms with cases of disease and those without, buy medicine from vet shops. Veterinary workers have a high risk factor as they move from household to household to treat pigs.
Traders	The risk of disease spread by traders is not high because commercial farms have control over who enters the farm and stables. Traders often do not come into the stables, in another hand, all pigs in a batch are sold at the same time (all in and all out).	Traders often using motorbikes to transport pigs and ask to see and select pigs from the stables at household farms. This presents a high risk factor for spread of disease. For the local black pig production in remote villages, the possibility of spreading the disease is also high in cases where farmers buy cheap diseased pigs from other villages, slaughter them and then share the pork, causing the spread of disease.
Pork retailers	They usually slaughter pork on the farm for consumption and do not buy pork from outside the area when there are disease outbreaks, therefore, the risk of spread is not high.	Retail agents also have a high risk of spreading disease to household farmers because these farmers buy meat from the market 2–3 times per week. If they buy pork from a sick pig, there is a possibility of spreading disease.

Source: Stakeholder feedback workshop (2021)

4. Capacity for diagnosis and monitoring of ASF and solutions for disease management

4.1. Resources, knowledge and practices of local authorities at different levels

Resources

The Lào Cai Subdepartment of Animal Health and Production and Aquaculture (SDAPA) at the provincial level has 22 staff with a bachelor's degree or higher. At the district level, each district

has an agricultural service centre with several staff who specialize in animal health and production. The Lào Cai SDAPA has a laboratory but the equipment is more than 15 years old and is unusable; the subdepartment also lacks specialized staff for disease tests, so samples are sent to the diagnostic centre in Hà Nội for testing.

In 2020, four slaughterhouses were built: one in Hoa Mac commune (Van Ban district), one in Gia Phu commune (Bảo Thắng District), one in Si Ma Cai town and one in Muong Khuong town. Currently, the two in Hoa Mac and Gia Phu are operational.

Knowledge

Every year, SDAPA officers are trained in disease prevention, control and surveillance. However, in-depth professional knowledge is still lacking. Currently, technical staff at the SDAPA are relatively proficient in surgery, diagnosis and disease identification. However, at the district level, some stations lack livestock and animal health specialised staffs and some stations such as those in Van Ban and Bao Yen districts have only three-to-four veterinary staffs. In some districts, the specialized veterinary staff they have were sent to work other jobs.

Practices

In 2020, Lào Cai Provincial People's Committee issued Plan No. 148 / KH-UBND dated 22 May 2020, On Emergency Prevention and Control of ASF in Lào Cai Province in the New Situation (Lào Cai Provincial People's Committee 2020a) and Plan No. 217 / KH-UBND dated 13 August 2020, Plan on Prevention and Control of ASF for the Period of 2020–2025 (Lào Cai Provincial People's Committee 2020b). These documents outlined a series of activities undertaken after the initial outbreak of ASF in beginning 2019.

Officials implemented the following disease prevention activities:

- + Immediately after learning about the ASF epidemic situation, the Sub- DAHVA conducted inspections, took samples and sent them to Hà Nội for disease testing. The Sub- DAHVA coordinated with communes, districts, towns, DARDs and district agricultural service centres to implement epidemic prevention and control measures according to existing regulations (MARD 2016; 2019). The Sub- DAHVA also provided them with guidance on the prevention of ASF, plans to combat ASF and biosecurity practices for pig production.
- + The Sub- DAHVA coordinated with localities to determine when to declare an epidemic and when to terminate that epidemic according to regulations.
- + The Provincial Steering Committee for Animal Disease Prevention and Control has been consolidated and strengthened, assigning specific tasks to each member and conducting checks at the local level.

- + Two temporary animal control posts were established.
- + Districts, towns and cities have set up nine mobile control groups. The agriculture officials set up working groups to support the response to ASF, including emergency capacities, in all nine districts, towns and cities.
- + The Sub- DAHVA promptly provided sufficient protective chemicals and equipment for epidemic prevention and control: 20,831 litres of chemicals for sterilization, decontamination, outbreak treatment and cleaning of breeding environments; 2,900 sets of biological protective suits; 2,900 pairs of gloves; 157 pairs of boots; and 90 pairs of safety glasses.
- + The Sub- DAHVA established working groups and coordinated with localities to strengthen inspection and supervision of epidemics among livestock and poultry.

The following steps were taken to improve disease understanding and capacity for monitoring of the Sub- DAHVA:

- +The Sub- DAHVA coordinated with the NIVR to implement a project entitled "Epidemiological Research and Biological Surveillance in Southeast Asia (SABER II)" for ASF and zoonotic diseases.
- + The Sub- DAHVA coordinated with the NIVR and the branch of Thai Nguyen University in Lào Cai Province to implement a project entitled "Research on Epidemiology of ASF and Development of Digital Maps of ASF in Lào Cai Province".
- + As far as disinfection activities, the Sub- DAHVA coordinated with localities twice to launch and implement a "month of cleaning, detoxing and disinfecting", which consisted of cleaning, and disinfection using 20,381 litres of chemicals.

The Sub-DAHVA has undertaken the following public communication activities:

- + Coordinating with the provincial radio and television authorities to implement programs.
- + Posting on the website of the Sub- DAHVA and posting bulletins in markets about animal husbandry, fisheries, disease prevention, epidemic diseases for livestock and poultry, management and use of veterinary drugs and animal feed.
- + Integrating contents on livestock policy, laws, and documents under the Livestock Law in guiding the implementation of livestock, animal health and disease safety, especially on ASF and avian influenza through training program plans, projects, seminars and conferences as well as public communications.

4.2.Potential and constraints

Advantages and potential in restocking pig herds after ASF outbreaks

A number of policies supporting pig restocking at different levels: Document 274 / SNN-CNTY dated 27 February 2020 On Enhancing Implementation of Safe Livestock Practices (MARD 2020a); Document 529 / SNN-CNTY dated 27 March 2020 On Organizing to Guide the Restocking, Increasing of Pig Herds to Ensure Biosecurity (MARD 2020b); Document 1399 / SNN-CNTY dated 8 July 2020 For the Implementation of Quality Management of Livestock Breeds (MARD 2020c); Document 2413 / SNN-CNTY dated 10 November 2020 Regarding Management of Pig Production to be Safe from Diseases in Village Communities (MARD 2020d).

These documents outlined the following activities and changes at different levels of government and in the private sector that can help to restock pig herds following the outbreaks of ASF:

- + Banks have created conditions for livestock producers to take out loans for restocking.
- + A plan to restock and develop sustainable pig husbandry for the period 2021–2025 is expected to use source from the national target program to support new rural development and expand local budgets for the development of breeding sows, building of artificial insemination facilities and enhancing pig farms' capacity for biosecurity measures.
- + Pig breeders and producers have shown increased awareness of disease prevention in livestock husbandry and increased use of lime powder for disinfection of the stable area.
- + After the outbreaks of ASF, some farms that have adopted biosecure practices have an opportunity to increase revenue due to higher pig prices, improving these farmers ability to restock their pig herds.
- + In Lào Cai Province, there are currently eight successful pig breeding farms applying advanced technology. These farms raise exotic pig breeds with closed pen systems and modern equipment such as semi-automatic feeding troughs, cooling panels for air purifiers, fan systems and waste systems, all of which are treated through biogas tunnels. These farms have been operating in closed value chains to ensure hygiene and disease safety according to Vietnamese Good Animal Husbandry Practices (VietGAHP).
- + Anh Nguyen Co., Ltd. in Bac Ha town, Bac Ha district operates a commercial farm with native black pigs using a closed value chain. The company practices breeding on biological pads and uses mixed feed produced on the farm. The company uses natural fermentation to create high-quality pork products while ensuring they are safe for consumers. The farm regularly breeds over 100 sows and 1,000 fatteners, providing a stable supply for the market in the province of 10–15 tonnes of pigs per month (over 100 pigs per month).
- + Quy Hien Poultry and Livestock Production Cooperative in Son Ha commune, Bảo Thắng District, uses an exotic pig and safe pork production chain that includes pig breeding on 12 satellite

farms managed by members of the cooperative and a system of sties and closed stables cooled by steam. The cooperative has one breeding sow farm with 700 exotic sows (including 100 great-grandparent and grandparent pigs) and 11 exotic boars as well as six fattening farms with 300-2,600 fatteners per batch. In addition, the cooperative is working with livestock farms in the area to expand their production, providing a stable supply for the domestic market of over 100 tonnes of pork per month (over 1,000 pigs per month).

+ In addition to the above farms, community-based pig groups and household farms in Thai Vo and Nam Du villages, in Xuan Quang commune, are described by local vet officers and farmers as disease-free areas. These farm groups have applied good disinfection practices using lime powder and kill rats around their barns. The families let only one person specialize in taking care of the pigs, restrict purchases of pork from outside the area and eat chicken only from the family farm. All households (59 households in Thai Vo village and 55 households in Nam Du village) that raise pigs in these villages had been free from ASF at time of the interview.

Difficulties and constraints in restocking pig herds after ASF outbreaks

According to interviewed pig producers, the biggest difficulties for restocking pig herds after ASF outbreaks on the farms and in the region are concerns about re-infection with ASF, high cost of breeding pigs and lack of capital, for both household and commercial farms. In addition, for household farms, access to breeding pigs with known origin is also difficult (see Table 19).

Table 19: Major difficulties of interviewed pig producers in restocking herds after ASF outbreaks (Scored 1- 5; 1 is the least significant difficulty and 5 is the most significant)

	All			Households			Commercial farms		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
Access to know origin breeding pigs	82	3.02	1.49	64	3.08	1.47	18	2.83	1.58
Unstable quality of breeding pigs	66	2.73	1.66	52	2.71	1.64	14	2.79	1.81
High cost of breeding pigs	82	3.84	1.44	64	3.94	1.39	18	3.50	1.62
High feed cost	82	2.56	1.15	64	2.50	1.08	18	2.78	1.35
Fear of re-infection with ASF	82	4.38	1.37	64	4.36	1.40	18	4.44	1.29
Lack of capital for restocking	82	2.94	1.49	64	2.94	1.56	18	2.94	1.21

Source: Pig producer interviews (2020)

Restocking of breeding sows is slow due to difficulties in purchasing quality breeds, especially exotic breeds. Restocking fatteners is also slow due to the high price of commercial piglets; the

price of commercial piglets for fattening in the area in the first 10 months of the year ranges from 2-3 million VND per piglet (weighing 8-10 kg).

ASF reappeared in the province in February 2020 and continued to spread until the end of the year, though there is often no official confirmation for cases of ASF, in part because a large number of households do not have a deep understanding about diseases and biosecurity. The majority of people now believe that any sickness or death among pigs is caused by ASF, causing farmers to be hesitant about restocking.

- + Small-scale production still accounts for a high proportion of pig production in the province. Many households with livestock have not yet invested in measures to prevent the spread of disease such as treatment of livestock waste. Material resources and technical qualifications among farming households are still limited, meaning few households can implement biosecurity practices.

- + Proactive surveillance, disease detection and epidemic reporting in some localities are not timely or are neglected. Direct inspections and supervision of epidemics from the grassroots level are not regular and strict. The detection of outbreaks is still slow, allowing disease to spread to many households.

- + Inspection and control of transportation of animals and animal products is still a challenge because people have not complied with regulations on transporting animals. Most districts do not have slaughter points that comply with regulations, increasing the risk of disease spread through the process of transporting, slaughtering and consuming pork.

- + Vaccination is still a challenge and the rate of vaccination is still low. The quality of vaccination efforts have improved, but this improvement is not evenly distributed among communes and localities. This is because some localities have not paid full attention to porcine vaccination due to the situation of COVID-19 combined with the ASF epidemic.

- + There are many animal feed and vet medicine shops in the area but official reviews of these shops, including updates to statistics, have not been timely. The number of samples taken for inspection and analysis is still small compared to the volume of goods circulating in the area.

- + Policies to support livestock smallholders are still limited.

4.3. Solutions

Solutions suggested by pig producers

Among the technical solutions discussed, both commercial and household pig producers considered minimizing the number of people going in and out of pig stables and improving healthcare and husbandry procedures to be both very important and feasible. The interviewees said

the other most important practices were strengthening decontamination and disinfection (using lime and hormones with higher frequency), disinfection of transport vehicles and killing of mice, flies and mosquitoes. These solutions are also considered highly feasible for adoption (see Table 20).

Table 20: Suggested technical and husbandry management measures to increase biosecurity and prevent disease on farms (Mean±SD)

(Scoring is 1–5 for importance; 1 is the least important and 5 is the most; scoring is 1–3 for feasibility; 1 is the least feasible and 3 is the most important).

Criteria	Household (n = 64)		Commercial farm (n=18)	
	Importance	Feasibility	Importance	Feasibility
<i>Technical solutions</i>				
Minimize the number of people going in and out of pig stables	4.73 ± 0.48	2.94±0.24	5.00±0.0	2.89±0.32
Improve animal healthcare and husbandry procedures	3.88 ±0.70	2.58±0.61	4.39±0.61	2.50±0.79
Supplements of probiotics, vitamins, yeast and electrolytes to improve the immune systems of animals	3.34±0.86	2.64±0.65	3.89±1.23	2.56±0.62
<i>Solutions for decontamination and disinfection of livestock areas and equipment</i>				
Strengthen decontamination and disinfection (using lime and hormones with higher frequency)	4.14±0.85	2.95±0.21	4.78±0.55	2.89±0.32
Install an antibacterial system in the feed warehouse	3.34±1.16	1.69±0.94	3.50±1.54	1.89±0.96
Disinfect transport vehicles going in and out of the farm	3.91±0.95	2.42±0.85	4.50±0.71	2.61±0.70
<i>Solutions to control insects and pathogens</i>				
Enclosing pig houses in nets	3.44±1.19	2.50±0.71	3.61±1.58	2.33±0.69
Strengthen killing of mice, flies and mosquitoes	3.88±0.86	2.73±0.60	4.28±0.67	2.78±0.73
Clear the bushes and clean the sewers around the farm	3.38±0.93	2.64±0.63	3.56±1.15	2.44±0.70

Source: Pig producer interviews (2020)

shows how pig producers scored solutions for monitoring inputs on farms and risk factors in pig market systems, as suggested by the interviewed pig producers. Household and commercial farms expressed the same priorities, emphasizing the need to minimize people coming to select pigs in the barn (farmers suggested sharing photos or videos instead); to strictly control animal transport; and to strictly control breeding animals imported to the farms.

Table 21 shows how pig producers scored solutions for monitoring inputs on farms and risk factors in pig market systems, as suggested by the interviewed pig producers. Household and commercial farms expressed the same priorities, emphasizing the need to minimize people coming to select pigs in the barn (farmers suggested sharing photos or videos instead); to strictly control animal transport; and to strictly control breeding animals imported to the farms.

Table 21 shows how pig producers scored solutions for monitoring inputs on farms and risk factors in pig market systems, as suggested by the interviewed pig producers. Household and commercial farms expressed the same priorities, emphasizing the need to minimize people coming to select pigs in the barn (farmers suggested sharing photos or videos instead); to strictly control animal transport; and to strictly control breeding animals imported to the farms.

Table 21: Solutions for monitoring inputs and market risk factors suggested by pig producers

(Scoring is 1–5 for importance; 1 is the least important and 5 is the most important; scoring is 1–3 for feasibility; 1 is the least feasible and 3 is the most feasible).

Criteria	Household (n = 64)		Commercial farm (n=18)	
	Importance	Feasibility	Importance	Feasibility
Strictly control breeding animal imports	4.47±0.78	2.53±0.71	4.83±0.51	2.56±0.62
Strictly control animal transport	4.44±0.75	2.72±0.55	4.89±0.32	2.67±0.59
Control sources of feed and animal husbandry materials/equipment	3.89±0.99	2.41±0.83	4.28±0.83	2.22±0.88
Minimize of people coming to select pigs in the barn	4.67±0.62	2.34±0.74	5.00±0.0	2.44±0.70

Source: Pig producer interviews (2020)

As for appropriate policies to overcome ASF, household farms suggested they would expect compensation or support when their pigs are killed due to ASF as well as support for purchasing disinfectants. Commercial farms expect support for purchasing disinfectants as well as materials and equipment for model housing (see Table 22).

Table 22: Policies to support pig farms to overcome ASF as suggested by producers

(Scoring is 1–5 for importance; 1 is the least important and 5 is the most important)

Criteria	All (n=82)		Household (n=64)		Commercial farm (n=18)	
	Mean	SD	Mean	SD	Mean	SD
Support/compensation for pigs killed due to ASF	3.87	1.47	4.00	1.35	3.39	1.82
Credit program for pig production	3.00	1.62	3.08	1.60	2.72	1.71
Capital for purchase of breeding pigs	3.43	1.16	3.44	1.02	3.39	1.58

Support for accessibility to good quality and known origin breeding pig	3.32	1.30	3.39	1.20	3.06	1.63
Support for vaccination	3.79	1.33	3.89	1.30	3.44	1.42
Support for disinfectants	4.10	1.26	4.09	1.27	4.11	1.28
Support for AI services	2.24	1.12	2.28	1.08	2.11	1.28
Technical support	3.74	1.27	3.83	1.14	3.44	1.65
Support for materials and equipment for pig housing	3.29	1.34	3.17	1.34	3.72	1.27

Source: Pig producer interviews (2020)

Solutions suggested by actors in the pig value chain

- + As the main cause of ASF is human, thoroughly and strictly control and disinfect humans and animals entering and leaving the breeding area. Pig-raising households need to be especially proactive in epidemic prevention.
- + Apply strict quarantine, sanitation and disinfection measures and upgrade material resources and livestock tools to ensure the effective application of biosecurity measures.
- + Farmers need to buy breeding animals from disease-free breeding farms, proactively produce breeding animals on-site to limit transportation and use feeds from known origins.
- + Units producing and supplying animal feed must strictly comply with the processes of production and disinfection and must destroy all feed and feed packaging recovered from farms.
- + Slaughterhouses must carefully handle waste. Slaughterhouses must be licensed and must not indiscriminately cause environmental pollution.
- + Live pigs must also have a disease safety certificate when transported and meat must be stored in a plastic bag when it is transported.

Solutions suggested by government and management at multiple levels

- + Strengthen biosecurity measures in pig production, restocking and breeding.
- + Prioritize sustainable development of organic livestock along with biosecure production in the value chains.
- + Carry out public communications, guide pig producers and breeders in restocking safely.
- + Encourage development of husbandry.
- + Strengthen management and supervision of epidemics at the local level in order to detect epidemics quickly, handle them in a timely manner and ensure compliance with regulations. Supervision for transport and trade of livestock and livestock products must also be strengthened.

- + Inspect and supervise breeding animal production in farm households periodically and unexpectedly, with a focus on checking breed quality standards.
- + Coordinate closely with the DARD and functional sectors to strengthen the state management regarding the use of veterinary drugs and animal feed.
- + Advise the implementation of the solutions on areas in the cities, towns, residential areas that are not allowed to raise livestock and support policies when relocating livestock farms out of the area where livestock is allowed.

Overall solutions validated in the stakeholder feedback workshop

Rank	Solutions	Remarks
1	Restore quarantine within the province	The deregulation of the province's quarantine measures under the Veterinary Law 2016 and the fact that quarantine is only required for only animals and animal products exported out of the province are causing many difficulties in controlling animal transport. There is a need to quarantine live animals and animal products transported between districts. In some cases, the animals come from outside the province might be declared as ones from the bordered district within the province.
2	Study on rapid test for ASF	Currently the minimum time for sampling, transporting samples, testing and getting results is 12 hours (depending on the area).
3	Consolidating the veterinary system	There is no longer a district veterinary system as multiple units were merged into an agricultural service centre, making it difficult for veterinary practices in general and disease control in particular. The agriculture service centre does not function as the vertical veterinary system did before.
4	Breeding animals must be produced from disease-free (certified) farms	Breeding pigs for re-stocking must be mainly done locally to reduce transportation. There are no large-scale specialized breeding farms within the province to supply the provincial market demand. Currently, breeding animals are mainly self-produced by pig producers or sourced from lowland provinces. The private specialized pig breeders need to be encouraged through supportive policies.
5	Report restocking to the commune-level authorities in order to receive support during the epidemic	Currently, farmers still restock using breeding animals of unclear origin. When there is no epidemic, there is no regulation for compensation or support in cases of disease. But when ASF occurs, if support is only given to households that have reported their pig production/restocking, the situation of selling and discarding diseased/dead pigs into the environment will be much more complicated. Human resources to check restocking conditions are lacking and allowances to support this are required.

6	Strong punishment for both buyers and sellers of diseased pigs	The selling of pigs to run out of occurred disease outbreak (“Lợn bán chạy”), including diseased pigs or pigs have a high risk of being infected. It will be difficult to sample from all pigs sold and sampling takes a long time.
7	Implementation of livestock declaration according to the 2018 Law on Animal Husbandry	There are existing regulations that have not been implemented or not been fully implemented due to lack of human and material resources (papers, printed materials). There is a need to specify what resources are required for this work.
8	Transport live pigs with a disease safety certificate	Requiring that all live pigs have a disease-free certificate is not feasible, especially for small household farms. This is could be replaced with a different commitment from producers (associated with the responsibility for the case of diseased pigs if any).

Source: Stakeholder feedback workshop (2021)

5. Training needs in the context of ASF

The priority for training needs in the context of ASF is quite similar between households and commercial farms. These include the detection and recognition of ASF and emerging diseases; understanding the risks of ASF infection and how to prevent it; training on breeds and controlled breeding practices; safe AI practices; and technical knowledge of sanitary and disease-free pig housing (Table 23). These results are also concurrent with the results of the pig producer FGD (Source: Pig producer interviews (2020)

Table 24).

Table 23: Training needs of interviewed farmers

(Scoring is 1–5 for importance; 1 is the least important and 5 is the most important)

Needs	All (n=82)		Households (n=64)		Commercial farms (n=18)	
	Mean	SD	Mean	SD	Mean	SD
Breeds and controlled breeding practices; safe AI practices	3.59	1.35	3.42	1.37	4.17	1.15
Technical knowledge of pig housing for sanitation and diseased control	3.65	1.25	3.59	1.26	3.83	1.25
Prevention and treatment for regular diseases	3.72	1.45	3.78	1.44	3.50	1.50
Detection and recognition of ASF and emerging diseases	4.51	0.91	4.45	0.97	4.72	0.57
Risks of ASF infection, how to prevent it	4.16	1.08	4.09	1.11	4.39	0.98
Livestock biosecurity practices	3.01	1.41	2.91	1.40	3.39	1.42

Treatment of pig waste and environmental protection	2.50	1.43	2.41	1.41	2.83	1.50
-----------------------------------------------------	------	------	------	------	------	------

Source: Pig producer interviews (2020)

Table 24: Training needs of farmers

(Scoring is 1–5 for importance; 1 is the least important and 5 is the most important)

Needs	Score	Note
Breeds and controlled breeding practices; safe AI practices	4	Professional AI practices are required for safety.
Technical knowledge of pig housing for sanitation and diseased control	4	This includes sanitation, disinfection and use of materials in the stables to reduce risk of pathogen infection.
Prevention and treatment for regular diseases	2	Farmers have rich experience in raising pigs and they can recognize regular pig diseases.
Detection and recognition of ASF and emerging diseases	5	Early detection and recognition of these diseases is very important to reduce the disease spread within and between farms.
Risks of ASF infection, how to prevent it	5	As there is no vaccine for ASF, understanding of disease transmission and prevention measures is very important.
Livestock biosecurity practices	3	
Treatment of pig waste and environmental protection	2	

Source: Pig producer FGD (2020)

Table 25 summarizes the training needs of vet and livestock officers.

Table 25: Training needs of vet and livestock officers

Needs	Rank	Note
Update techniques such as those for detecting and treating emerging and common diseases	1	This is applicable in career development and providing services.
Improve professional qualifications and treatment skills and knowledge of livestock diseases	2	
Visits to learn good practices on pilot farms and biosecure farms in order to do public communications for farmers	3	

Participate in research and scientific studies	4	This will also help to build capacity.
------------------------------------------------	---	----------------------------------------

Source: Pig producer FGD (2020)

The training needs expressed by other stakeholders in the pig value chain, including slaughterers and retailers were as follows:

- + Training on new techniques for safety and hygiene practices at slaughter.
- + Training for breeders and other stakeholders on safe pig raising methods, how to prevent epidemics and how to treat sick pigs while preventing disease spread.
- + Training courses on risks and pathways of disease transmission for all stakeholders to avoid trading infected pigs.

Conclusion

There is a high risk of ASF transmission from traders in the pig value chain, including collectors, slaughterers and retailers at the provincial, district and commune levels. These actors all participate in the sale and purchase of pigs that could be infected. Further, live pigs and pig products are not subject to quarantine within the province and their transport is not controlled. In addition, when an epidemic occurs, it takes a long time to identify the disease due to the lack of resources and capacity among local animal husbandry actors and the inability to analyse samples locally to detect ASF. This allows time for pathogens to spread through transport and sales of sick pigs. The results of this study indicate that farms that had no cases of ASF now tend to apply more biosecurity measures in pig production than those that had pigs with ASF.

Officers at provincial and district levels have limited resources and capacity for monitoring and surveillance of ASF. There is a need for compliance by all pig producers and other actors in the pig value chain to adopt biosecurity practices. Therefore, awareness, knowledge and understanding of infection and risks of ASF need to be improved. Veterinary officials at the provincial and district levels need to improve capacity and resources to perform rapid tests for ASF and need to coordinate with local actors on the control and prevention of ASF in the community.

References

- Bảo Thắng District DARD (Department of Agriculture and Rural Development). 2018. *Annual Report on Agriculture, Socio-economic Development of the District*.
- Bảo Thắng District DARD (Department of Agriculture and Rural Development). 2019. *Annual Report on Agriculture, Socio-economic Development of the District*.

Bảo Thắng District DARD (Department of Agriculture and Rural Development). 2020. *Annual Report on Agriculture, Socio-economic Development of the District*.

DLP (Department of Livestock Production). 2019. *Report on ASF of Department of Livestock Production* (unpublished report)

Government of Vietnam. 2020. *Decree No. 13/2020/ND-CP: Elaboration on the Law on Animal Husbandry*. Hà Nội, Vietnam: Government of Vietnam.

Lào Cai Provincial People's Committee. 2020. *Plan No. 148 / KH-UBND: On Emergency Prevention and Control of ASF in Lào Cai Province in the New Situation*.

Lào Cai Provincial People's Committee. 2020. *Plan No. 217 / KH-UBND: Plan on Prevention and Control of ASF for the Period of 2020–2025*.

Lào Cai Sub- DAHVA (Sub- department of Animal Husbandry, Veterinary and Aquaculture). 2018. *Annual report on animal health and production of Lào Cai Province*.

Lào Cai Sub- DAHVA. 2019. *Annual report on animal health and production of Lào Cai Province*.

Lào Cai Sub- DAHVA. 2020. *Annual report on animal health and production of Lào Cai Province*.

MARD, 2020: statistical data and figure on pig price 2019-2020

MARD (Ministry of Agriculture and Rural Development). 2016. *Circular No. 07/2016 / TT-BNNPTNT: Regulations on Prevention and Control of Terrestrial Animal Diseases*. Hà Nội, Vietnam: MARD.

MARD. 2019. *Circular No. 04/2019 / TT-BNNPTNT: Amending and Supplementing a Number of Articles of the Circular No. 07/2016 / TT-BNNPTNT*. Hà Nội, Vietnam: MARD.

MARD. 2020. *Document 274 / SNN-CNTY: On Enhancing Implementation of Safe Livestock Practices*. Hà Nội, Vietnam: MARD.

MARD. 2020. *Document 529 / SNN-CNTY: On Organizing to Guide the Restocking, Increasing of Pig Herds to Ensure Biosecurity*. Hà Nội, Vietnam: MARD.

MARD. 2020. *Document 1399 / SNN-CNTY: For the Implementation of Quality Management of Livestock Breeds*. Hà Nội, Vietnam: MARD.

MARD. 2020. *Document 2413 / SNN-CNTY: Regarding Management of Pig Production to be Safe from Diseases in Village Communities*. Hà Nội, Vietnam: MARD.

National Assembly of the Socialist Republic of Vietnam. 2018. *Law on Animal Husbandry*. Hà Nội, Vietnam: National Assembly of the Socialist Republic of Vietnam.

Annexe

Annex 1: Consent form

Consent form

Agreement to participate in the interview

Study title: Identification of risk factors for ASF along pig value chain in Lào Cai Province

Name of the interviewer:

The ILRI and NIAS (National Institute of Animal Science) are conducting a study on the pig value chain in the province to investigate the risk factors of African swine fever (ASF). Through this study we intend to conduct an assessment of what is needed to raise awareness, disseminate information and train various stakeholders to better prevent and manage ASF, thereby helping to propose suitable solutions in managing and minimizing the impact of the epidemic.

Please note that personal information will not be reported and all information will be anonymized. The interview will last about 60-90 minutes. It should be noted that participation in this survey is completely voluntary. Also, the interview process will not be offensive to you in any way. However, if you find any of the questions offensive you are free to not answer the specific question or withdraw from the research entirely. If you wish to withdraw, simply notify the investigator and notes up to that point will be deleted and will not be included in the study.

This study complies with the School of Public Health's Ethical Evaluation Process Guidelines. If you have any concerns or would like more information about the project, please contact Le Thi Thanh Huyen at the NIAS, Tel: 0904854499; email: lehuyen1973@yahoo.com

Asked for and received verbal consent before being released for the interview ☐

Annex 2: Interview with officers responsible for veterinary care and livestock production

**INTERVIEW
OFFICERS RESPONSIBLE FOR VETERINARY CARE AND LIVESTOCK PRODUCTION**

Province/ district/ commune

Investigation of the current status of pig production and ASF in the province

Level: provincial district communal

A. GENERAL INFORMATION

Organization:

Province/ City: District:

Full name: Age:

Sex: ☐ Male ☐ Female Tel:

Years in the job: (Years)

B. CURRENT STATUS OF ANIMAL FARM, SCALE AND PRODUCTIVITY

B1. Number of pig farms of different types in the locality

Criteria	Current			Main changes compared to before ASF (2018)
	Number	%	Main location distribution	
Total breeding farms				
- No. of GGP and GP pig farms				
- No. of parent farms				
Total fattening farms				
- Household farms (<10 LU) ³				
- Small farms (10–30 LU)				
- Medium farms (30–300 LU)				
- Large farms (>300 LU)				
Pig cooperatives				
Biosecurity practice farms (VietGAPH, Biosecurity farms)				

B2. Total pigs and breeds

Criteria	Current				Main changes compared to before ASF (2018)
	No. (pigs)	Local breed (%)	Crossbreed (%)	Exotic breed (%)	
SOWS					
Total GGP, GP pigs					
Total parent pigs and gilts					
Total piglets					
BOARS					
Total boars for producing semen for AI					
Total boars for natural mating					
FATTENERS					
Total (pigs)					

Percentage of breeding pigs produced within the locality?.....

³ Household farm = <50 fatteners; small farm = 50–150 fatteners; medium farm = 150–1,500 fatteners; large farms = >1,500 fatteners

If breeding pigs are imported, from where?.....

B3. Annual pig out puts

Type	2018	2019	2020
Number of pig sold			
Annual yield (tonne of LW/ year)			

Estimation of percentage consumed within the locality (province/district/commune)?.....

For consumption outside the locality, where is the market?.....

C. PIG PRODUCTION DEVELOPMENT IN THE CONTEXT OF ASF

C1. Direct losses caused by ASF: No. pigs died, destroyed by ASF, cost for disinfection

2019:

No. of pigs died/destroyed..... Expenses for disinfection.....

2020:

No. of pigs died/destroyed..... Expenses for disinfection.....

C2. How has ASF impacted the livelihoods of pig producers?

Type of pig production	Pigs lost due to ASF		Level of impact to livelihood of the producer (scoring from 1 to 5 according to the importance of the impact)	Note
	Percentage of farms with cases of ASF	Average number of pigs died from ASF per farm (min-max)		
Large breeding farm/ company				
Large fattening farm/ company				
Medium fattening farm				
Small fattening farm				
Household raising breeding sows				
Household raising fatteners				
Cooperative				

C3. Main pig chains in the locality?

C4. Main changes in pig markets caused by ASF?

C5. Assessment of local capacity for diagnosis, monitoring, recognition, prevention and management of ASF?

Resources:

Knowledge:

Practices:

C6. Situation of implementation of policy for restocking, increasing pig herd after ASF?

C7. Difficulties and advantages in restocking pig herd, solutions?

C8. Plans and solutions in the locality for the prevention and management of ASF (short term and long term)

C9. Biosecure production in the locality: models, programs, brief descriptions of outcomes, difficulties and solutions

Annex 3: Interview pig retailer

**INTERVIEW
PIG RETAILERS
(Commune, village)**

ID:.....

Level: Commune.....Village.....

I. General information

- Name: Tel:
- Village: Commune:
- District: Province:
- Years with this job:
- Number of labourers for this job.....(people)
- Area of the shop.....m2
- Location of shop:.....

II. Scale and business

2.1. Average amount of purchase /MONTH (kg)

Product	Current	Percentage of purchased from outside locality (commune/ village)	What change from ASF
Dressing pork			
Others_____			

2.2. Source of pigs and pork (%)

Product	Industrial slaughter house	Manual slaughterhouse	Other traders	Others
Dressing pork				
Others_____				

Percentage of pigs/pork purchased from outside locality?

Main changes from ASF?.....

2.3. Pig, pork sale (%)

Product	Restaurant	Other traders	Direct consumers	Others
Dressing pork				
Others_____				

Main changes from ASF?.....

2.4. Facilities, vehicles

Facilities	How to clean	Main changes from ASF
Truck		
Motorbikes		
Fridge		
Pig stable area		

III. Drawing the value chain map you are participating in:

- a. Mapping (from pig producers to consumer, added value at nodes, percentages of products to nodes, how transport? Quarantine...)
 - b. Main changes when ASF occurring?
- IV. Difficulties caused by ASF?**
- V. Training needs?**

Annex 4: interview pig producers

ID:.....

**INTERVIEW
PIG PRODUCER**

☐ ever with pigs got ASF on the farm ☐ never with pigs got ASF on the farm

Production scale

☐ Large farm⁴ ☐ Medium farm ☐ Small farm ☐ Household farm

Type of pig producer ☐ traditional pig producer ☐ GAP⁵ ☐ free disease pig producer⁶ ☐ biosecurity pig producer⁷

☐ others

A. GENERAL

A1. General information

Province/: District:

Commune: Village:

Name of producer: Age:

Sex: ☐ Male ☐ Female Tel:

Years raising pigs:

A2. Labour

i. Family members:(people)

ii. Number of labourers:(people)

iii. Family labour participating in pig production: (people)

iv. Hired labour for pig production: (people)

v. Part time labourer for pig production: (man day per year)

B. STRUCTURE, PRODUCTION SCALE AND PRODUCTION TYPES

B1. Production scale, breed structure

Pig type	12/2020 (current)				12/2018 (before ASF)			
	Quantity (pig)	Local breed (%)	Crossbreed (%)	Exotic breed (%)	Quantity (pig)	Local breed (%)	Crossbreed (%)	Exotic breed (%)
BREEDING BOAR								
Boar for semen collection								
Boar for natural mating								
Boar with individual testing ⁸								
SOW								
Gilt								
Reproductive sow								
Piglet								
FATTENER								
Lợn thịt								

Reasons of changes in pig herd size if any

⁴ Household farm <50 fatteners; small farm 50–150 fatteners; medium farm 150–1500 fatteners; large farm >1500 fatteners

⁵ **GAP (Good Agricultural Practices):**.

⁶ **ATDB:** pig farms free from diseases with the duration fit for specific ones.

⁷ **ATSH:** Producer apply aggregated solutions technical and management methods to prevent the contact of animal with pathogen in order to ensure healthy animal, no disease.

⁸ **Đực giống kiểm tra năng suất cá thể:** là việc kiểm tra, đánh giá lại năng suất, chất lượng, khả năng kháng bệnh của đực giống đảm bảo chất lượng giống phù hợp tiêu chuẩn.

☐ died by disease ☐ early sale due to disease ☐ sale as inefficient
☐ Others

Losses caused by ASF

Boars died: (pig); value: (triệu); subsidised amount: (million VND)

Sows died: (pig); value: (triệu); subsidised amount: (million VND)

Fatteners died: pig); value: (triệu); subsidised amount: (million VND)

B2. Way of pig production

Feeds (multiple choices):

☐ TMR ☐ self-mixed feed ☐ available feeds
☐ swill feed
☐ Others

Stable (multiple choices):

☐ Closed stable ☐ Open stable ☐ Other

C. BIOSECURITY ADOPTION SITUATION

Note: Dark marked rows only for farm

TT	Criteria for biosecurity	1-non adopted; 2-not full adopted; 3-Adopted	
		Current (12/2020)	Before ASF T12/2018)
C1.	Requirements for barns and livestock equipment		
1	Construction location is consistent with local land use planning or allowed		
2	The distance from pig stables to residential areas and industrial zones must be at least 100m		
3	Animal husbandry area separated from housing		
4	There is a closed wall of the Animal husbandry area		
5	Take measures to prevent insects and vectors from transmitting diseases (mice, birds, flies, mosquitoes ...)		
6	There is quarantine place for new and diseased pigs		
7	There is a separate feeding trough for each cage		
8	There are separate livestock tools for each row of pens		
9	There is area of sanitation, disinfection, and change of work clothes		
10	There is a place for feed to be ventilated, not mouldy, easy to clean, and take measures against mice and insects		
11	There is a place for veterinary drugs, chemicals, and disinfection that are safe, well ventilated and easy to clean		
12	There is a waste collection and treatment area		
C2.	Requirement for animals		
13	Pigs have clear origin, healthy and have quarantine certificates		
14	Before entering the herd, pigs are kept in quarantine for at least 30 days.		
C3.	Feed and drinking water		
15	Use of feed with clear origin,		
16	Feed is not spoiled, musty, is not out of date, ensuring quality and safety.		
17	Feed is suitable for each stage and farming purpose		
18	Do not use leftovers in the feed troughs of discharged pigs or infected pigs' feed for new pigs.		
19	<i>Use of swill (kitchen waste), if used, is it cooked or not before feeding the pig? (mark 1 if not sd, if yes mark 3 cooked or 3 not cooked)</i>		
20	Adding probiotics in feed to strengthen the pig's resistance (e.g., using yeast, herbs).		

TT	Criteria for biosecurity	1-non adopted; 2-not full adopted; 3-Adopted	
		Current (12/2020)	Before ASF T12/2018)
21	Use of antibiotics, chemicals with clear origin (brand, origin, date for use)		
22	Have a full record and keep information about feed import, export and use, and information when using antibiotics mixed with food.		
23	The water source for pigs must be safe.		
C4.	Health care and husbandry		
24	Application of the management method "all in- all out" in order of priority: the whole area, the row of pens, the barn cell (explain the term to the farmer).		
25	There is a production process for each type of pig matching with production purposes.		
26	Application of dry farming method, do not use bath water for pigs.		
27	Use probiotics in drinking water, litter and periodically mist in the house according to the manufacturer's instructions (e.g., bio-pads, yeasts, herbs).		
28	The barn is suitable for each age of animals and farming purpose		
C5.	Sanitation and control of people in and out of the farm.		
30	There is a disinfection pit at the farm gate, barn row, barn gate		
31	Disinfectants including lime at the sanitizing pit added or changed daily,		
32	Make changes to the disinfectant to increase the disinfectant effect.		
33	Having sufficient tools and equipment to disinfect the farm		
34	Before entering the breeding area, people must bathe, change clothes, shoes and wear protective equipment of the farm		
35	Before and after entering and exiting the barn to disinfect hands, dip boots into the disinfection pit.		
36	Immediately after visitors leaving the barn, it is necessary to spray disinfectants in the barn area with a concentration 2–3 times higher than the usual procedure.		
37	Livestock workers have to eat and stay at the farm for at least 4 weeks before changing; do not bring fresh food from outside to the farm;		
38	Arrange breeders and technicians, means of transporting feed for each production area.		
39	Periodically spray disinfectant around the farm with appropriate disinfectant solutions according to manufacturer's instructions (<i>The barn at least 2 times / week; spray antiseptic in the barn at least 1 time / week in the absence of disease, and at least 2 times / week in the event of disease; spray antiseptic on pigs at least 2 times / week when epidemic is available</i>) Or use lime		
40	Periodically clear the bush, clear and clean the sewers outside the barn at least 2 times / month.		
41	Clean feed and drink troughs daily. Equipment, tools and means serving livestock production must be regularly disinfected.		
42	Cleaning, disinfection and disinfection of barns, livestock tools after each raising patch		

TT	Criteria for biosecurity	1-non adopted; 2-not full adopted; 3-Adopted	
		Current (12/2020)	Before ASF T12/2018)
43	Leave the barn empty for at least 7 days before getting new pigs. In case of epidemic outbreaks, if re-stocking should be left empty for at least 30 days and get approval from local authorities.		
C6	Control of means of transport and equipment		
44	Do not let vehicles from other places go directly to the pig farm. Means of transport must stop outside the farm to clean, and disinfect twice (30 minutes apart) before entering.		
45	Do not transport pigs, feed, waste or other tools in the same vehicle.		
46	Do not share veterinary equipment between rows of pens.		
C7.	Treatment of livestock waste		
47	There is a waste treatment system		
48	Solid waste (faeces) must be collected daily, transported to a collection site and treated by heat, either with chemicals, or with a suitable biological preparation (e.g. Compost, composting machine)		
49	Wastewater line from barn to closed treatment area. Wastewater from any cell barn drains that cell into the common road		
50	Liquid waste must be treated with chemicals or by an appropriate biological treatment.		
C8	Disease management		
51	There are pig herd records and records of disease, causes of occurrence, and medicines for prevention and treatment.		
52	There are appropriate prevention procedures for pig types and follow the correct procedures		
53	When there are sick pigs, they must keep a quarantine stable;		
54	When an epidemic is detected, it must notify the local authority to take measures to handle it;		
55	Diseased pigs are handled according to the guidance of the veterinary agency.		
56	When epidemic occurs in a cell cage or the whole stables, it is necessary to disinfect at the place, cover, ...		
57	Stop the export of pigs and strictly control the output of products and materials in the stable area when there is an epidemic.		
58	Packages and feed containers of infected pigs must be disinfected.		
C9.	Internal recording and inspection		
59	Pig farms must have books, record, and store information during the husbandry process.		
60	Workers are trained on livestock-veterinary procedures		

Transporting pigs in - out of the farm:

Transport breeding pigs to the farm:

- Who is in charge? (Buyer or Seller?)
 - Vehicles?
- Cleaning and disinfection of means of transport (method, frequency)?

Transporting pigs for sale out of farms:

Who is in charge? (Buyer or Seller?)

- Vehicles?
- Cleaning and disinfection of means of transport (method, frequency)?

D. PRODUCTION - PRODUCTION PRICE - CONSUMPTION

1. Đàn lợn giống

Sow production

Sow productivity	2020	Before ASF (2018)
Total weaned piglets		
Total sold as breeding piglets		

Calculate the cost to produce breeding pig (calculated for 1 litter including the cost for the mother and piglets to weaned, excluding depreciation of fixed cost and labour cost). Unit: 1,000 VND

Parameters	Unit	2020			Before ASF (2018)		
		<i>Number</i>	<i>Unit cost</i>	<i>Amount</i>	<i>Number</i>	<i>Unit cost</i>	<i>Amount</i>
Value of sow at beginning	pig	1			1		
Value of culled sow	pig	1			1		
Number of litters/sow	litter						
Average number of weaned piglets/litter	pig						
Feed cost/litter	kg						
- For pregnant sow	kg						
- For lactating sow	kg						
- for piglets	kg						
AI cost	time						
Vet cost/litter	1,000 VND						
- Vaccine	1,000 VND						
- Medicine	1,000 VND						
- Disinfection	1,000 VND						
Other costs/litter	1,000 VND						
Estimated breeding cost per piglet	1,000 VND						
Average cost of a breeding pig							

Sale of breeding piglets

Chỉ Tiêu	2020	Before ASF (2018)
Piglets kept on farm	<input type="checkbox"/> sale as breeding pig <input type="checkbox"/> kept for fattening <input type="checkbox"/> Others ...	<input type="checkbox"/> sale as breeding pig <input type="checkbox"/> kept for fattening <input type="checkbox"/> Others ...
If you sell breeding pig, to whom?	<input type="checkbox"/> Trader <input type="checkbox"/> other pig producer <input type="checkbox"/> participating in a value chain <input type="checkbox"/> Other ...	<input type="checkbox"/> Trader <input type="checkbox"/> other pig producer <input type="checkbox"/> participating in a value chain <input type="checkbox"/> Other ...
If you sell breeding pig, contract?	<input type="checkbox"/> no contract <input type="checkbox"/> oral agreement <input type="checkbox"/> written contract <input type="checkbox"/> Other	<input type="checkbox"/> no contract <input type="checkbox"/> oral agreement <input type="checkbox"/> written contract <input type="checkbox"/> Other
Place to sell breeding pig	<input type="checkbox"/> At the farm (.....%) <input type="checkbox"/> Market (.....%)	<input type="checkbox"/> At the farm (.....%) <input type="checkbox"/> Market (.....%)
Buyers from where	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)

D2. Fatteners

Productivity

Productivity	2020	Before ASF (2018)
Number of sale (pig)		
Average weight at sale (kg/pig)		
Where to sell	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)

Production cost per slaughtered pig (excluded discounted fixed and labour cost) Unit: 1,000 VND

Parameter	Unit	2020			Before ASF outbreak (2018)		
		Quantity	Unit cost	Amount	Quantity	Unit cost	Amount
Raising duration	days						
Cost for breeding pig	kg						
Feed cost	kg						
Vet cost	1,000 VND						
- Vaccine	1,000 VND						
- Medicine	1,000 VND						
- Disinfection	1,000 VND						
Other costs	1,000 VND						
Off taken	kg						

Sale of fattener

Parameters	2020	Before ASF (2018)
To whom (total of 100%)	<input type="checkbox"/> Trader (.....%) <input type="checkbox"/> slaughter men (.....%) <input type="checkbox"/> participating in a VC (.....%) <input type="checkbox"/> Other (.....%)	<input type="checkbox"/> Trader (.....%) <input type="checkbox"/> slaughter men (.....%) <input type="checkbox"/> participating in a VC (.....%) <input type="checkbox"/> Other (.....%)
Buyer from where	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)
Contract?	<input type="checkbox"/> No <input type="checkbox"/> Oral agreement <input type="checkbox"/> Written contract <input type="checkbox"/> Other	<input type="checkbox"/> No <input type="checkbox"/> Oral agreement <input type="checkbox"/> Written contract <input type="checkbox"/> Other

E. RESTOCKING AFTER ASF**E1. Origin of imported pigs**

	2020	Before ASF (2018)
Sow and gilt (total of 100%)	<input type="checkbox"/> from company farm (.....%) <input type="checkbox"/> private farm (.....%) <input type="checkbox"/> from state farm (.....%) <input type="checkbox"/> own farm produced (.....%) <input type="checkbox"/> others (.....%)	<input type="checkbox"/> from company farm (.....%) <input type="checkbox"/> private farm (.....%) <input type="checkbox"/> from state farm (.....%) <input type="checkbox"/> self-produced (.....%) <input type="checkbox"/> others (.....%)

	2020	Before ASF (2018)
Where to buy sow	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)
Boar, semen ((total of 100%))	<input type="checkbox"/> from company farm (.....%) <input type="checkbox"/> private farm (.....%) <input type="checkbox"/> from state farm (.....%) <input type="checkbox"/> own farm produced (.....%) <input type="checkbox"/> others (.....%)	<input type="checkbox"/> from company farm (.....%) <input type="checkbox"/> private farm (.....%) <input type="checkbox"/> from state farm (.....%) <input type="checkbox"/> own farm produced (.....%) <input type="checkbox"/> others (.....%)
Where to buy boar/ semen	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)
Fattener (Total of 100%)	<input type="checkbox"/> from company farm (.....%) <input type="checkbox"/> private farm (.....%) <input type="checkbox"/> from state farm (.....%) <input type="checkbox"/> own farm produced (.....%) <input type="checkbox"/> others (.....%)	<input type="checkbox"/> from company farm (.....%) <input type="checkbox"/> private farm (.....%) <input type="checkbox"/> from state farm (.....%) <input type="checkbox"/> own farm produced (.....%) <input type="checkbox"/> others (.....%)
Where to buy fattener	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)

Evaluation of breeding animal quality

Source of pig	Quality of the breeding animal (1-worse; 2-medium; 3-good)	Stability of the quality (1-unstable; 2-medium; 3-very stable)
<input type="checkbox"/> From company (CP, Dabaco...)	○1 ○2 ○3	○1 ○2 ○3
<input type="checkbox"/> Private farm	○1 ○2 ○3	○1 ○2 ○3
<input type="checkbox"/> State farm	○1 ○2 ○3	○1 ○2 ○3
<input type="checkbox"/> Other	○1 ○2 ○3	○1 ○2 ○3

E2. Breeding

Way of breeding	Unit	2020	Before ASF (2018)
<input type="checkbox"/> AI	%		
<input type="checkbox"/> natural mating service	%		
<input type="checkbox"/> use of farm owned boar	%		

E3. Vaccination

2020	Before ASF (2018)
<input type="checkbox"/> FMD	<input type="checkbox"/> FMD
<input type="checkbox"/> RSS	<input type="checkbox"/> RSS
<input type="checkbox"/> Swine fever	<input type="checkbox"/> Swine fever
<input type="checkbox"/> Swine typhoid	<input type="checkbox"/> Swine typhoid
<input type="checkbox"/> Pasteurellosis	<input type="checkbox"/> Pasteurellosis
<input type="checkbox"/> Leptolosis	<input type="checkbox"/> Leptolosis
<input type="checkbox"/> Circo (stunt syndrome)	<input type="checkbox"/> Circo (stunt syndrome)
<input type="checkbox"/> Myco	<input type="checkbox"/> Myco
<input type="checkbox"/> Sticky lung inflammation	<input type="checkbox"/> Sticky lung inflammation
<input type="checkbox"/> Acute diarrhoea	<input type="checkbox"/> Acute diarrhoea
<input type="checkbox"/> ...	<input type="checkbox"/> ...

E4. Difficulty in restocking after ASF (scoring 1 from 1 to 5 with 5 being the most difficult)

Criteria	Scoring
<input type="checkbox"/> Difficult to access to the original breeding pig	○1 ○2 ○3 ○4 ○5

<input type="checkbox"/> Original pigs but unstable quality	○1	○2	○3	○4	○5
<input type="checkbox"/> High price of breeding pigs	○1	○2	○3	○4	○5
<input type="checkbox"/> High feed cost	○1	○2	○3	○4	○5
<input type="checkbox"/> Get ASF	○1	○2	○3	○4	○5
<input type="checkbox"/> Lack of capital	○1	○2	○3	○4	○5
<input type="checkbox"/> Others	○1	○2	○3	○4	○5

F. SOLUTIONS

F1. Solutions to increase application of technical measures to ensure biosecurity in livestock production and prevent epidemics

Effective score (1 to 5 with 5 being the most effective)

Feasibility (1. not feasible, 2. feasible, 3. very feasible)

Solutions	Score for efficiency	Feasibility
Technical solution		
<input type="checkbox"/> Minimize people in and out of the farm		
<input type="checkbox"/> Improve animal husbandry procedure, prevent epidemics		
<input type="checkbox"/> Additional probiotics, vitamins, electrolytes ...		
<input type="checkbox"/> Others		
Solutions to decontaminate and disinfect livestock areas and equipment for livestock		
<input type="checkbox"/> Enhancing detoxification and disinfection (lime, hormones with higher doses)		
<input type="checkbox"/> Install an antibacterial system in feed storage		
<input type="checkbox"/> Spraying disinfectant to vehicles in and out of the farm		
<input type="checkbox"/> Others		
Solutions to control insects and pathogens		
<input type="checkbox"/> Nets tighten around the barn		
<input type="checkbox"/> Strengthen killing mice, flies, mosquitoes		
<input type="checkbox"/> Clearing bushes, clearing drains		
<input type="checkbox"/> Others		
Control solutions for supply of breeding animal, transport, feed and materials		
<input type="checkbox"/> Strict control of breeding animal import		
<input type="checkbox"/> Control of animal transport		
<input type="checkbox"/> Control of feed sources and materials		
<input type="checkbox"/> Others		
Market		
<input type="checkbox"/> Minimize people to buy pigs getting in the barn (just via vendor showing pictures)		
<input type="checkbox"/> Others		

F2. The supporting policies and implemented (Evaluation: 1-not yet practical; 2-practical; 3-very practical)

Policies	Evaluation	Remark
<input type="checkbox"/> Subsidy for destroy pig due to ASF	○1 ○2 ○3	
<input type="checkbox"/> Support of materials and disinfection	○1 ○2 ○3	
<input type="checkbox"/> Support vaccination	○1 ○2 ○3	
<input type="checkbox"/> Subsidy of boar/ semen	○1 ○2 ○3	
<input type="checkbox"/> Subsidy of gilt, sow	○1 ○2 ○3	
<input type="checkbox"/> Subsidy of breeding piglets	○1 ○2 ○3	
<input type="checkbox"/> Support of technical training	○1 ○2 ○3	
<input type="checkbox"/> Others	○1 ○2 ○3	

Note

F3. Proposed supporting policies to develop pig production

(Marking: scoring from 1 to 5 with 5 is essential)

Policies	Scoring				
<input type="checkbox"/> Support to destroy pigs suffering from ASF	O1	O2	O3	O4	O5
<input type="checkbox"/> Credit support	O1	O2	O3	O4	O5
<input type="checkbox"/> Capital support for breeding pig	O1	O2	O3	O4	O5
<input type="checkbox"/> Support accessing to original quality pigs	O1	O2	O3	O4	O5
<input type="checkbox"/> Support vaccination	O1	O2	O3	O4	O5
<input type="checkbox"/> Support disinfection	O1	O2	O3	O4	O5
<input type="checkbox"/> Support for breeding (semen, AI cost, materials ...)	O1	O2	O3	O4	O5
<input type="checkbox"/> Technical training	O1	O2	O3	O4	O5
<input type="checkbox"/> Supporting materials and equipment	O1	O2	O3	O4	O5
<input type="checkbox"/> Others...	O1	O2	O3	O4	O5
<input type="checkbox"/> Others...	O1	O2	O3	O4	O5
<input type="checkbox"/> Others...	O1	O2	O3	O4	O5

G. Demand for capacity building training (1–5 according to importance)

Animal husbandry	Score
Controlled breeding, and development of AI to ensure disease safety	
Stable techniques ensure technology, hygiene and safety of epidemics	
Veterinary, prevention of common diseases	
Detecting ASF disease and some emerging diseases	
The risks of infection with ASF and how to prevent the disease	
Biosecurity farming solutions at farm households	
Waste treatment and environmental protection	
<i>others</i>	

Annex 5: Interview pig breeder

ID:.....

**INTERVIEW
PIG BREEDERS**

Large-scale, small-scale, farmer households, provide breeding piglet or commercial piglets for fattening

☐ ever with pigs got ASF on the farm ☐ never with pigs got ASF on the farm

Type of production

☐ produce parent pigs to produce commercial piglets ☐ commercial piglet for fattening

Production scale

☐ Large farm⁹ ☐ Medium farm ☐ Small farm ☐ Household farm

Type of pig producer

☐ traditional pig producer ☐ GAP¹⁰ ☐ free disease pig producer¹¹ ☐ biosecurity pig producer¹²

☐ others

A. GENERAL

A1. General information

Province/: District:

Commune: Village:

Name of producer: Age:

Sex: ☐ Male ☐ Female Tel:

Years raising pigs:

A2. Labour

i. Family members:(people)

ii. Number of labourers:(people)

iii. Family labour participating in pig production: (people)

iv. Hired labour for pig production: (people)

v. Part time labourer for pig production: (man day per year)

B. STRUCTURE, PRODUCTION SCALE AND PRODUCTION TYPES

B1. Production scale, breed structure

Pig type	12/2020 (current)				12/2018 (before ASF)			
	Quantity(pig)	Local breed (%)	Crossbreed (%)	Exotic breed (%)	Quantity(pig)	Local breed (%)	Crossbreed (%)	Exotic breed (%)
BREEDING BOAR								
Boar for semen collection								
Boar for natural mating								
Boar with individual testing ¹³								
SOW								
Gilt								
Reproductive sow								

⁹ Household farm <50 fatteners; small farm 50–150 fatteners; medium farm 150–1500 fatteners; large farm >1500 fatteners

¹⁰ **GAP (Good Agricultural Practices):**.

¹¹ **ATDB:** pig farms free from diseases with the duration fit for specific ones.

¹² **ATSH:** Producer apply aggregated solutions technical and management methods to prevent the contact of animal with pathogen in order to ensure healthy animal, no disease.

¹³ **Đực giống kiểm tra năng suất cá thể:** là việc kiểm tra, đánh giá lại năng suất, chất lượng, khả năng kháng bệnh của đực giống đảm bảo chất lượng giống phù hợp tiêu chuẩn.

Piglet								
FATTENER								
Lợn thịt								

Reasons of changes in pig herd size if any

- ☐ died by disease
 ☐ early sale due to disease
 ☐ sale as inefficient
 ☐ Others

Losses caused by ASF

Boars died: (pig); value: (triệu); subsidised amount: (million VND)

Sows died: (pig); value: (triệu); subsidised amount: (million VND)

Fatteners died: pig); value: (triệu); subsidised amount: (million VND)

B2. Way of pig production

Feeds (multiple choices):

- ☐ TMR ☐ self-mixed feed
 ☐ available feeds
 ☐ swill feed
 ☐ Others

Stable (multiple choices):

- ☐ Closed stable
 ☐ Open stable
 ☐ Other

If raising pigs, is the barn different from above? If so, please choose

- ☐ closed stable
 ☐ open stable
 ☐ other

C. BIOSECURITY ADOPTION SITUATION

Note: Dark marked rows only for farm

TT	Criteria for biosecurity	1-non adopted; 2-not full adopted; 3-Adopted	
		Current (12/2020)	Before ASF T12/2018)
C1.	Requirements for barns and livestock equipment		
1	Construction location is consistent with local land use planning or allowed		
2	The distance from pig stables to residential areas and industrial zones must be at least 100m		
3	Animal husbandry area separated from housing		
4	There is a closed wall of the Animal husbandry area		
5	Take measures to prevent insects and vectors from transmitting diseases (mice, birds, flies, mosquitoes ...)		
6	There is quarantine place for new and diseased pigs		
7	There is a separate feeding trough for each cage		
8	There are separate livestock tools for each row of pens		
9	There is area of sanitation, disinfection, and change of work clothes		
10	There is a place for feed to be ventilated, not mouldy, easy to clean, and take measures against mice and insects		
11	There is a place for veterinary drugs, chemicals, and disinfection that are safe, well ventilated and easy to clean		
12	There is a waste collection and treatment area		
C2.	Requirement for animals		
13	Pigs have clear origin, healthy and have quarantine certificates		
14	Before entering the herd, pigs are kept in quarantine for at least 30 days.		
C3.	Feed and drinking water		
15	Use of feed with clear origin,		

TT	Criteria for biosecurity	1-non adopted; 2-not full adopted; 3-Adopted	
		Current (12/2020)	Before ASF T12/2018)
16	Feed is not spoiled, musty, is not out of date, ensuring quality and safety.		
17	Feed is suitable for each stage and farming purpose		
18	Do not use leftovers in the feed troughs of discharged pigs or infected pigs' feed for new pigs.		
19	<i>Use of swill (kitchen waste), if used, is it cooked or not before feeding the pig? (mark 1 if not sd, if yes mark 3 cooked or 3 not cooked)</i>		
20	Adding probiotics in feed to strengthen the pig's resistance (e.g., using yeast, herbs).		
21	Use of antibiotics, chemicals with clear origin (brand, origin, date for use)		
22	Have a full record and keep information about feed import, export and use, and information when using antibiotics mixed with food.		
23	The water source for pigs must be safe.		
C4.	Health care and husbandry		
24	Application of the management method "all in- all out" in order of priority: the whole area, the row of pens, the barn cell (explain the term to the farmer).		
25	There is a production process for each type of pig matching with production purposes.		
26	Application of dry farming method, do not use bath water for pigs.		
27	Use probiotics in drinking water, litter and periodically mist in the house according to the manufacturer's instructions (e.g., bio-pads, yeasts, herbs).		
28	The barn is suitable for each age of animals and farming purpose		
C5.	Sanitation and control of people in and out of the farm.		
30	There is a disinfection pit at the farm gate, barn row, barn gate		
31	Disinfectants including lime at the sanitizing pit added or changed daily,		
32	Make changes to the disinfectant to increase the disinfectant effect.		
33	Having sufficient tools and equipment to disinfect the farm		
34	Before entering the breeding area, people must bathe, change clothes, shoes and wear protective equipment of the farm		
35	Before and after entering and exiting the barn to disinfect hands, dip boots into the disinfection pit.		
36	Immediately after visitors leaving the barn, it is necessary to spray disinfectants in the barn area with a concentration 2–3 times higher than the usual procedure.		
37	Livestock workers have to eat and stay at the farm for at least 4 weeks before changing; do not bring fresh food from outside to the farm;		
38	Arrange breeders and technicians, means of transporting feed for each production area.		

TT	Criteria for biosecurity	1-non adopted; 2-not full adopted; 3-Adopted	
		Current (12/2020)	Before ASF T12/2018)
39	Periodically spray disinfectant around the farm with appropriate disinfectant solutions according to manufacturer's instructions (<i>The barn at least 2 times / week; spray antiseptic in the barn at least 1 time / week in the absence of disease, and at least 2 times / week in the event of disease; spray antiseptic on pigs at least 2 times / week when epidemic is available</i>) Or use lime		
40	Periodically clear the bush, clear and clean the sewers outside the barn at least 2 times / month.		
41	Clean feed and drink troughs daily. Equipment, tools and means serving livestock production must be regularly disinfected.		
42	Cleaning, disinfection and disinfection of barns, livestock tools after each raising patch		
43	Leave the barn empty for at least 7 days before getting new pigs. In case of epidemic outbreaks, if re-stocking should be left empty for at least 30 days and get approval from local authorities.		
C6.	Control of means of transport and equipment		
44	Do not let vehicles from other places go directly to the pig farm. Means of transport must stop outside the farm to clean, and disinfect twice (30 minutes apart) before entering.		
45	Do not transport pigs, feed, waste or other tools in the same vehicle.		
46	Do not share veterinary equipment between rows of pens.		
C7.	Treatment of livestock waste		
47	There is a waste treatment system		
48	Solid waste (faeces) must be collected daily, transported to a collection site and treated by heat, either with chemicals, or with a suitable biological preparation (e.g. Compost, composting machine)		
49	Wastewater line from barn to closed treatment area. Wastewater from any cell barn drains that cell into the common road		
50	Liquid waste must be treated with chemicals or by an appropriate biological treatment.		
C8.	Disease management		
51	There are pig herd records and records of disease, causes of occurrence, and medicines for prevention and treatment.		
52	There are appropriate prevention procedures for pig types and follow the correct procedures		
53	When there are sick pigs, they must keep a quarantine stable;		
54	When an epidemic is detected, it must notify the local authority to take measures to handle it;		
55	Diseased pigs are handled according to the guidance of the veterinary agency.		
56	When epidemic occurs in a cell cage or the whole stables, it is necessary to disinfect at the place, cover, ...		
57	Stop the export of pigs and strictly control the output of products and materials in the stable area when there is an epidemic.		

TT	Criteria for biosecurity	1-non adopted; 2-not full adopted; 3-Adopted	
		Current (12/2020)	Before ASF T12/2018)
58	Packages and feed containers of infected pigs must be disinfected.		
C9.	Internal recording and inspection		
59	Pig farms must have books, record, and store information during the husbandry process.		
60	Workers are trained on livestock-veterinary procedures		

Does the above apply to all types of pigs, including fatteners?

If not, what is fundamentally different?

Transporting pigs in - out of the farm:

Transport breeding pigs to the farm:

- Who is in charge? (Buyer or Seller?)

- Vehicles?

- Cleaning and disinfection of means of transport (method, frequency)?

Transporting pigs for sale out of farms:

Who is in charge? (Buyer or Seller?)

- Vehicles?

- Cleaning and disinfection of means of transport (method, frequency)?

D. PRODUCTION - PRODUCTION PRICE – CONSUMPTION

Sow production

Sow productivity	2020	Before ASF (2018)
Total weaned (piglets)		
Total sold as breeding piglets		

Calculate the cost to produce breeding pig (calculated for 1 litter including the cost for the mother and piglets to weaned, excluding depreciation of fixed cost and labour cost). Unit: 1,000 VND

Parameters	Unit	2020			Before ASF (2018)		
		Number	Unit cost	Amount	Number	Unit cost	Amount
Value of sow at beginning	pig	1			1		
Value of culled sow	pig	1			1		
Number of litters/sow	litter						
Average number of weaned piglets/ litter	pig						
Feed cost/ litter	kg						
- For pregnant sow	kg						
- For lactating sow	kg						
- for piglets	kg						
AI cost	time						
Vet cost/ litter	1,000 VND						
- Vaccine	1,000 VND						
- medicine	1,000 VND						
- disinfection	1,000 VND						

Parameters	Unit	2020			Before ASF (2018)		
		Number	Unit cost	Amount	Number	Unit cost	Amount
Other costs/ litre	1,000 VND						
Estimated breeding cost per a piglet	1,000 VND						
Average cost of a breeding pig							

Sale of breeding piglets

Chỉ Tiêu	2020	Before ASF (2018)
Piglets kept on farm	<input type="checkbox"/> sale as breeding pig <input type="checkbox"/> kept for fattening <input type="checkbox"/> Others ...	<input type="checkbox"/> sale as breeding pig <input type="checkbox"/> kept for fattening <input type="checkbox"/> Others ...
If you sell breeding pig, to whom?	<input type="checkbox"/> Trader <input type="checkbox"/> other pig producer <input type="checkbox"/> participating in a value chain <input type="checkbox"/> Other ...	<input type="checkbox"/> Trader <input type="checkbox"/> other pig producer <input type="checkbox"/> participating in a value chain <input type="checkbox"/> Other ...
If you sell breeding pig, contract?	<input type="checkbox"/> no contract <input type="checkbox"/> oral agreement <input type="checkbox"/> written contract <input type="checkbox"/> Other	<input type="checkbox"/> no contract <input type="checkbox"/> oral agreement <input type="checkbox"/> written contract <input type="checkbox"/> Other
Place to sell breeding pig	<input type="checkbox"/> At the farm (.....%) <input type="checkbox"/> Market (.....%)	<input type="checkbox"/> At the farm (.....%) <input type="checkbox"/> Market (.....%)
Buyers from where	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)

E. RESTOCKING AFTER ASF

E1. Origin of imported pigs

	2020	Before ASF (2018)
Sow and gilt (total of 100%)	<input type="checkbox"/> from company farm (.....%) <input type="checkbox"/> private farm (.....%) <input type="checkbox"/> from state farm (.....%) <input type="checkbox"/> own farm produced (.....%) <input type="checkbox"/> others (.....%)	<input type="checkbox"/> from company farm (.....%) <input type="checkbox"/> private farm (.....%) <input type="checkbox"/> from state farm (.....%) <input type="checkbox"/> self-produced (.....%) <input type="checkbox"/> others (.....%)
Where to buy sow	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)
Boar, semen ((total of 100%)	<input type="checkbox"/> from company farm (.....%) <input type="checkbox"/> private farm (.....%) <input type="checkbox"/> from state farm (.....%) <input type="checkbox"/> own farm produced (.....%) <input type="checkbox"/> others (.....%)	<input type="checkbox"/> from company farm (.....%) <input type="checkbox"/> private farm (.....%) <input type="checkbox"/> from state farm (.....%) <input type="checkbox"/> own farm produced (.....%) <input type="checkbox"/> others (.....%)
Where to buy boar/ semen	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)
Fattener (Total of 100%)	<input type="checkbox"/> from company farm (.....%) <input type="checkbox"/> private farm (.....%) <input type="checkbox"/> from state farm (.....%) <input type="checkbox"/> own farm produced (.....%) <input type="checkbox"/> others (.....%)	<input type="checkbox"/> from company farm (.....%) <input type="checkbox"/> private farm (.....%) <input type="checkbox"/> from state farm (.....%) <input type="checkbox"/> own farm produced (.....%) <input type="checkbox"/> others (.....%)

	2020	Before ASF (2018)
Where to buy fattener	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)	<input type="checkbox"/> in the commune (.....%) <input type="checkbox"/> in the district (.....%) <input type="checkbox"/> in the province (.....%)

Evaluation of breeding animal quality

Source of pig	Quality of the breeding animal (1-worse; 2-medium; 3-good)	Stability of the quality (1-unstable; 2-medium; 3-very stable)
<input type="checkbox"/> From company (CP, Dabaco...)	○1 ○2 ○3	○1 ○2 ○3
<input type="checkbox"/> Private farm	○1 ○2 ○3	○1 ○2 ○3
<input type="checkbox"/> State farm	○1 ○2 ○3	○1 ○2 ○3
<input type="checkbox"/> Other	○1 ○2 ○3	○1 ○2 ○3

E2. Breeding

Way of breeding	Unit	2020	Before ASF (2018)
<input type="checkbox"/> AI	%		
<input type="checkbox"/> natural mating service	%		
<input type="checkbox"/> use of farm owned boar	%		

E3. Vaccination

2020	Before ASF (2018)
<input type="checkbox"/> FMD	<input type="checkbox"/> FMD
<input type="checkbox"/> RSS	<input type="checkbox"/> RSS
<input type="checkbox"/> Swine fever	<input type="checkbox"/> Swine fever
<input type="checkbox"/> Swine typhoid	<input type="checkbox"/> Swine typhoid
<input type="checkbox"/> Pasteurellosis	<input type="checkbox"/> Pasteurellosis
<input type="checkbox"/> Leptosis	<input type="checkbox"/> Leptosis
<input type="checkbox"/> Circo (stunt syndrome)	<input type="checkbox"/> Circo (stunt syndrome)
<input type="checkbox"/> Myco	<input type="checkbox"/> Myco
<input type="checkbox"/> Sticky lung inflammation	<input type="checkbox"/> Sticky lung inflammation
<input type="checkbox"/> Acute diarrhoea	<input type="checkbox"/> Acute diarrhoea
<input type="checkbox"/> ...	<input type="checkbox"/> ...

E4. Difficulty in restocking after ASF (scoring 1 from 1 to 5 with 5 being the most difficult)

Criteria	Scoring
<input type="checkbox"/> Difficult to access to the original breeding pig	○1 ○2 ○3 ○4 ○5
<input type="checkbox"/> Original pigs but unstable quality	○1 ○2 ○3 ○4 ○5
<input type="checkbox"/> High price of breeding pigs	○1 ○2 ○3 ○4 ○5
<input type="checkbox"/> High feed cost	○1 ○2 ○3 ○4 ○5
<input type="checkbox"/> Get ASF	○1 ○2 ○3 ○4 ○5
<input type="checkbox"/> Lack of capital	○1 ○2 ○3 ○4 ○5
<input type="checkbox"/> Others	○1 ○2 ○3 ○4 ○5

F. SOLUTIONS

F1. Solutions to increase application of technical measures to ensure biosecurity in livestock production and prevent epidemics

Effective score (1 to 5 with 5 being the most effective)

Feasibility (1.not feasible, 2.feasible, 3. very feasible)

Solutions	Score for efficiency	Feasibility
Technical solution		
<input type="checkbox"/> Minimize people in and out of the farm		

<input type="checkbox"/> Improve animal husbandry procedure, prevent epidemics		
<input type="checkbox"/> Additional probiotics, vitamins, electrolytes ...		
<input type="checkbox"/> Others		
Solutions to decontaminate and disinfect livestock areas and equipment for livestock		
<input type="checkbox"/> Enhancing detoxification and disinfection (lime, hormones with higher doses)		
<input type="checkbox"/> Install an antibacterial system in feed storage		
<input type="checkbox"/> Spraying disinfectant to vehicles in and out of the farm		
<input type="checkbox"/> Others		
Solutions to control insects and pathogens		
<input type="checkbox"/> Nets tighten around the barn		
<input type="checkbox"/> Strengthen killing mice, flies, mosquitoes		
<input type="checkbox"/> Clearing bushes, clearing drains		
<input type="checkbox"/> Others		
Control solutions for supply of breeding animal, transport, feed and materials		
<input type="checkbox"/> Strict control of breeding animal import		
<input type="checkbox"/> Control of animal transport		
<input type="checkbox"/> Control of feed sources and materials		
<input type="checkbox"/> Others		
Market		
<input type="checkbox"/> Minimize people to buy pigs getting in the barn (just via vendor show pictures)		
<input type="checkbox"/> Others		

F2. The supporting policies and implemented (Evaluation: 1-not yet practical; 2-practical; 3-very practical)

Policies	Evaluation			Remark
<input type="checkbox"/> Subsidy for destroy pig due to ASF	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	
<input type="checkbox"/> Support of materials and disinfection	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	
<input type="checkbox"/> Support vaccination	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	
<input type="checkbox"/> Subsidy of boar/ semen	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	
<input type="checkbox"/> Subsidy of gilt, sow	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	
<input type="checkbox"/> Subsidy of breeding piglets	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	
<input type="checkbox"/> Support of technical training	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	
<input type="checkbox"/> Others	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	

Note if any:

F3. Proposed supporting policies to develop pig production

(Marking: scoring from 1 to 5 with 5 is essential)

Policies	Scoring				
<input type="checkbox"/> Support to destroy pigs suffering from ASF	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	<input type="radio"/> 04	<input type="radio"/> 05
<input type="checkbox"/> Credit support	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	<input type="radio"/> 04	<input type="radio"/> 05
<input type="checkbox"/> Capital support for breeding pig	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	<input type="radio"/> 04	<input type="radio"/> 05
<input type="checkbox"/> Support accessing to original quality pigs	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	<input type="radio"/> 04	<input type="radio"/> 05
<input type="checkbox"/> Support vaccination	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	<input type="radio"/> 04	<input type="radio"/> 05
<input type="checkbox"/> Support disinfection	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	<input type="radio"/> 04	<input type="radio"/> 05
<input type="checkbox"/> Support for breeding (semen, AI cost, materials ...)	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	<input type="radio"/> 04	<input type="radio"/> 05
<input type="checkbox"/> Technical training	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	<input type="radio"/> 04	<input type="radio"/> 05
<input type="checkbox"/> Supporting materials and equipment	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	<input type="radio"/> 04	<input type="radio"/> 05
<input type="checkbox"/> Others...	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	<input type="radio"/> 04	<input type="radio"/> 05
<input type="checkbox"/> Others...	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	<input type="radio"/> 04	<input type="radio"/> 05
<input type="checkbox"/> Others...	<input type="radio"/> 01	<input type="radio"/> 02	<input type="radio"/> 03	<input type="radio"/> 04	<input type="radio"/> 05

G. Demand for capacity building training (1–5 according to importance)

Animal husbandry	Score
------------------	-------

Controlled breeding, and development of AI to ensure disease safety	
Stable techniques ensure technology, hygiene and safety of epidemics	
Veterinary, prevention of common diseases	
Detecting ASF disease and some emerging diseases	
The risks of infection with ASF and how to prevent the disease	
Biosecurity farming solutions at farm households	
Waste treatment and environmental protection	
<i>others</i>	

Annex 6: Interview Slaughterhouse

ID:.....

**INTERVIEW
SLAUGHTERMEN
(Province/ district/commune)**

Level: ☐ Province ☐ District ☐ Commune

I. CHARACTERIZATION**1.1. General information**

- Name: Tel:
 - Village: Commune:
 - District: Province:
 Foundation year:.....

1.2. Scale

Total area m²
 Housing area m²
 Pig stable area m²
 Area of waste treatment m²
 Regular labour:
 Part time labour:

1.3.Capacity, main facilities

Total annual pig slaughtered (pig or kg):
 Capacity (pigs/day):
 Industrial slaughter chain:
 Manual slaughter facilities: (:
 Vehicles to transport pigs?
 Water source ?

1.4. Slaughtering

Way of slaughtering	%
Close slaughter chain	
Manual slaughter	

II. PIG SOURCES - SALE - TRANSPORT**2.1. Source of purchased pigs? (average per year)**

	Stakeholders	% of purchased pigs	% from outside locality	Changes when ASF
1	Household farms			
2	Farms			
3	Contracted farm			
6	Traders/ collectors			
7	Others			
	Total	100%		

2.2. How to transport live pigs to the slaughterhouse?:

- Who responsible (sellers or buyers?)
 - Vehicle (truck, motorbike)?
 - cleaning, disinfection (how, frequency)?
- 2.3. What changes in purchase, and transport when ASF? how?

2. 4. To whom slaughtered pig is sold (average per year)

STT	Stakeholders	% of sold pigs	% to outside locality	Changes when ASF
1	Wholesalers			
2	Pig processor			
3	Retailers			

4	Restaurant			
5	Others.....			
	Total	100%		

2.5. How slaughtered pigs is transported to ?

Who responsible (sellers or buyers)?

- Vehicle (truck, motorbike)?

- cleaning, disinfection (how, frequency)?

2.6. What changes in selling and transporting slaughtered pigs? And how?

III. CLEANING, ENVIRONMENTAL TREATMENT

3.1. Distance from pig stable to slaughter area?

3.2. How to clean and do disinfection slaughter areas (how, frequency)?

3.3. What changes from time occurring ASF?

If yes, how?

3.4. Methods of environmental treatment after slaughtering?

- Solid waste?

- solution waste?

III. DRAWING THE VALUE CHAIN MAP YOU ARE PARTICIPATING

- a. Mapping (from pig producers to consumer, added value at nodes, percentages of products to nodes, how transport? Quarantine...)

3.1. Main changes when ASF occurring?

IV. Difficulties caused by ASF??

V. TRAINING NEEDS?

For increase in biosecurity, decrease in impact to transmission of ASF

 VI. Please give recommendations for the treatment of slaughtering and processing wastes, including clarification, legal regulations on technical criteria and preferential policies to facilitate better livestock waste treatment in the context of ASF.

 VII. Recommendations are made on the need to develop sector standards for the management of live pigs, carcasses and pork in the pork value chain, including giving specific examples of this standard in the context of ASF

Annex 7: Interview pig collector and/ or transporter

ID:.....

**INTERVIEW
PIG COLLECTOR AND/OR TRANSPORTER
(province, district, commune)**

Level: ☐ Province ☐ District ☐ Commune

I. General information

- Name: Tel:
- Village: Commune:
- District: Province:
- Years with this job:
- Number of labourers for this job.....(people)

II. Scale and business

2.1. Average amount of purchase /MONTH (kg)

Product	Current	Percentage of purchased from outside locality (commune/ village)	What change from ASF
Dressing pork			
Others_____			

2.2. Source of pigs and pork (%)

Product	Industrial slaughter house	Manual slaughterhouse	Other traders	Others
Dressing pork				
Others_____				

Percentage of pigs/pork purchased from outside locality?

Main changes from ASF?.....

2.3. Pig, pork sale (%)

Product	Restaurant	Other traders	Direct consumers	Others
Dressing pork				
Others_____				

Main changes from ASF?.....

2.4. Facilities, vehicles

Facilities	How to clean	Main changes from ASF
Truck		
Motorbikes		
Fridge		
Pig stable area		

III. Drawing the value chain map you are participating in:

3.1. Mapping (from pig producers to consumer, added value at nodes, percentages of products to nodes, how transport? Quarantine...)

3.2. Main changes when ASF occurring?

IV. Difficulties caused by ASF?

.....

V. Training needs?

.....

VI. Proposed government regulations on trading / transporting live pigs

.....

Annex 8: FGDs with local officers

CONTENTS OF THE GROUP DISCUSSION ON TRAINING NEEDS OF VETERINARY AND AGRICULTURAL EXTENSION OFFICERS

Social provincial districts:

Time:

Coordinator: **Recorder:**

List of FGD participants (name, location, work address)

1.1. PART 1: Evaluation of working conditions

(Using SWOT to evaluate difficulties, advantages, challenges, potentials of veterinary and agricultural extension activities in the locality)

Advantages (qualifications, staff network, experience, salary support ...) 	Challenges (large area, low allowances, policies, regimes ... small pigs, people do not pay much attention to disease prevention and treatment, do not apply biosecurity measures in livestock production, especially What challenges due to the specialized quality)
Difficulties (related to themselves such as qualifications, experience, thin, thick network, rarely updated information, especially what difficulties due to ASF...) 	Opportunities (policies, regimes, farmers' welcome, potentials for developing local pig production ...)

PART 2: CURRENT SITUATION OF ASF IN LOCAL (PROVINCE / DISTRICT)

2.1. How does the degree of ASF impact farmers' livelihoods?

Type of pig production	Loss of pigs by ASF		Level of the impact to livelihood of the producer (scoring from 1 to 5 according to the importance of the impact)	Note
	Percentage of farms got ASF	Average pig died by ASF/ farm (min-max)		
Breeding large farm/ company				
Fattening large farm/ company				
Fattening medium farm				
Fattening small farm				
Household raising breeding sows				
Household raising fatteners				
Cooperative				

2.2. What factors are considered to be the risk of infection with ASF in the locality?

2.3. (Provide information on what resources, knowledge and practices are required to prevent ASF transmission in immediate future)

	<i>Current status</i>	<i>Difficulties, challenges, and gaps</i>	<i>Advantages, potential and expectation</i>	<i>Solutions short and long term</i>
<i>Resource</i>				
<i>Knowledge</i>				
<i>Practices and actions</i>				

2.4. (Provide a brief assessment on the diagnostic and surveillance capacity of the Lào Cai Province to detect, prevent and control ASF)?

2.5. Are policies, programs and projects related to the control of ASF in the locality?

Current :

Gaps, difficulties and challenges

PART 3: TRAINING NEEDS

Proposing training courses for health workers and extension workers to bring into play the potential for disease control and ASF management in the locality

<i>Training need</i>	<i>Priority</i>	<i>Explanation</i>

Annex 9: FGDs with farmers

FGDS WITH FARMERS

Commune: **District:**..... **Province:**

Time:

Facilitator:..... **Notetaker:**

I. 2 groups on pig production system and market (2–3 villages)

1. Group 1: 7–8 pig producers of different production scales discuss pig production and market:

List of FGN participants (name, address)

1.1. Current percentage of pig producers?

.....

1.2. Changes of this percentage during the last five years, explanation

.....

1.3. Classification of major local pig production systems (by scale, breed, ratio on total)

<i>Farm type</i>	<i>Description of the basic characteristics of each system</i>	<i>What has changed in the past 5 years</i>
	<ul style="list-style-type: none"> - Average current production scale, (max-min) - Main pig breeds (local, crossbreed, exotic) - Main feeds - Disease prevention and treatment (by farmers them self, vet, how...) - Application of biosecurity, how - Level of ASF in the locality 	Increase/ decrease of production scale, breeds, price, prevention and treatment ways, biosecurity adoption changes through the important years?
Farm, company		
Households		
Cooperative		

1.1. Markets

<i>Farm type</i>	<i>Description of the basic characteristics of each system</i>	<i>What has changed in the past 5 years</i>
	<p>In puts:</p> <ul style="list-style-type: none"> - Sources of breeding animal suppliers, how to transport, quarantine? - Breeding service (natural mating, AI) - Main feed source, local and external suppliers <p>Output:</p> <ul style="list-style-type: none"> - The main stakeholders selling products in the area, outside the locality (free traders, slaughtering, collecting ...) breeding pigs, porkers - How to transport products - Average quantity and annual output 	How to changes through the important years
Farm, company		
Households		
Cooperative		

1.2. How does the degree of ASF impact farmers' livelihoods?

<i>Farm type</i>	Loss of pigs by ASF		Level of the impact to livelihood of the producer (scoring from 1 to 5 according to the importance of the impact)	Note
	<i>Percentage of units having ASF</i>	<i>Average percentage of pig died (min-max)</i>		
Households raising exotic sows to sell breeding piglets				
Households doing fattening exotic pigs				

Households raising local sows to sell breeding piglets				
Household raising local fatteners				

2. *Group 2: 7–8 pig producers of different production scales discussing linkages in pig production, supply and consumption chains*

Participants

2.1. Mapping the main local pig supply chains, ration of product chains: From producer to consumer

2.2. Venn mapping linking producers to other actors in the pig supply and consumption chain: Important direct relationships (bold / thin arrows), frequency of contact (write frequency along the arrow), far, near distance (arrow length, inside, outside locality, province, district, commune); assess the risk of pathogen transmission through relationships (1. Danger, 2. No danger, 3. Don't know), explain?

1.3. SWOT: evaluation for pig production and pig production on biosecurity of farmers

Advantage (inner force) Available resources Tradition and experience in animal husbandry	Khó khăn (nội lực) Difficulty (internal force) Investment capital, small farming The technical level Difficult to access guaranteed animal sources due to small scale Difficulty caused by ASF
Potentials (external factors: programs, projects, policies, information, innovation....)	Challenges (external factors: service, market, policies, emerging diseases....) Challenges caused by ASF

II. 2 groups of training needs assessment

2.1. *Group discussion with pig farmers (one male and female group; 6–8 farmers / group): Training Needs Assessment (TNA) to understand the current situation, gaps and expectations about resources, knowledge and practices required to prevent transmission of ASF; as well as solutions for awareness raising, information dissemination and training needs.*

List of participants (name, address)

2.1.1. Identify the knowledge gaps of pig producers: resources, knowledge, practice

ST T	Matters of concern	1 Outline of current status of pig production and related activities and services	2. Problems, obstacles, difficulties (gaps) (corresponding to the current conditions included)	3. Desiring to improve (corresponding to the items listed below)
1	Current status and knowledge of original breeding pigs			
2	Current status and understanding of breeding and services (AI, natural mating, sire source and quality)			
3	Current status and understanding of foster care (using antibiotic in feed, probiotics ...?)			
5	The situation of disease prevention and treatment, veterinary services (vaccines, bio-products use ...) current diseases in local pigs; especially prevention of ASF			
6	Understanding the high risks of ASF transmission, recognizing the signs of ASF, preventing ASF?			

7	Current status and understanding of applicable solutions to minimize ASF spread and impact?			
8	Current status of barns, barn hygiene and surrounding environment in pig farming			
9	Current status and understanding of farmers applying biosecurity in the locality			
10	Consumption, transportation, trading (buyers, sellers, modes of transport, within communes, inter-communes, inter-districts, inter-provinces, biosecurity in transportation?), High-risk hubs in the supply chain?			

2.1.2. Evaluate and classify the need to improve pig production capacity of households (1–5 increase according to demand)

Capacity	Score
Controlled breeding, breeding, and development of AI to ensure disease safety	
Pig housing techniques ensure technology, hygiene and safety of epidemics	
Veterinary, prevention of common diseases	
Detection of ASF and some emerging diseases	
The risks of ASF infection and how to prevent it	
Biosecurity farming solutions at farm households	
Waste treatment in pig production and environmental protection	
<i>others</i>	

Annex 10: list of participants attending the stakeholder feedback workshop

List of participants of the Workshop
(on 13/01/2021, at Bảo Thắng Agricultural Service Center)

STT	Họ tên	Position
1	Le Thi Thanh Huyen	Researcher of NIAS
2	Hàn Anh Tuấn	Researcher of NIAS
3	Điình Khánh Thùy	Researcher of NIAS
4	Fred Unger	Researcher of ILRI
5	Lee Hu Suk	Researcher of ILRI
6	Bùi Nghĩa Vượng	Researcher of NVIR
7	Phạm Văn Quảng	Deputy of Lào Cai Sub- DAHVA
8	Nguyễn Quang Chiến	Officer of Lào Cai Sub- DAHVA
9	Nguyễn Đình Tâm	Officer of Lào Cai Sub- DAHVA
10	Trần Trọng Thể	Head of Bảo Thắng Agricultural Service Center
11	Phạm Văn Thê	Officer of Bảo Thắng Agricultural Service Center
12	Phạm Văn Tuấn	Officer of Bảo Thắng Agricultural Service Center
13	Phạm Thị Thùy Linh	Officer of Bảo Thắng Agricultural Service Center
14	Trần Thị Diêu	Officer of Bảo Thắng Agricultural Service Center
15	Vũ Trọng Thủy	Xuân Quang communal vet worker
16	Đỗ Thị Thu Ba	Phong Hải communal vet worker
17	Nguyễn Hữu Nghĩa	Gia Phú pig farmer
18	Lê Mạnh Quý	Pig producer from cooperative
19	Trần Bá Duyên	Xuan Quang pig trader