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A risk assessment for the introduction of African swine fever into the Pacific Island countries

(TCP/SAP/3805)

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by

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Table of contents

Executive summary

The EpiCentre, School of Veterinary Sciences, Massey University, and the Food and Agriculture Organization of the United Nations (FAO) carried out a risk assessment mission in the Pacific Island countries (PICs) under the FAO Technical Cooperation Program (GLEWS, TCP/SAP/3801 and TCP/SAP/3805). The objective of the assessment was to evaluate the likelihood of introducing the African swine fever virus (ASFV) into the eight PICs[1], i.e. the Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Samoa, Solomon Islands, Tuvalu and Vanuatu. The risk assessment findings were then utilized to recommend measures that can prevent or minimize the effects of ASF incursion in the PICs. This report provides a regional summary of the risk assessment and the corresponding measures recommended.

African swine fever (ASF) is a viral disease that is highly infectious and affects both domestic and wild pigs. It originated in Africa and has now spread to Eastern Europe, China, and Southeast Asia. Following recent outbreaks of ASF in Asia and Papua New Guinea, Pacific Island nations are now focusing on preventing the virus from being introduced. The first step is to conduct an import risk assessment of ASFV to determine the main ways the virus can be introduced and spread. This knowledge is essential for making informed decisions on the measures that are likely most effective in preventing or mitigating the impact of ASF in the PICs.

The risk assessment was conducted using the WOAH import risk analysis framework. The most likely pathway for introducing ASFV into the PICs was through contaminated pork products that international arrival passengers may bring in via airport or seaport. If contaminated items are brought into the PICs, pigs may be exposed to ASFV through their regular consumption of household food waste (swill), creating a clear path for transmission. Given the absence of farm-level biosecurity measures and the existence of wild pigs, the possibility of ASFV spreading to other susceptible pigs is deemed very high.

The assessment method was a systematic, qualitative import risk analysis of ASFV introduction to the PICs. Results provide information about high-risk areas for ASF introduction, exposure and spread in the PICs. They also identify gaps in control and prevention measures. The following steps are being proposed to minimize the likelihood of entry and exposure and the consequence of ASFV introduction.

Key recommendations for PICs region are to:

1. Increase awareness of incoming passengers about meat products and fomites that can carry ASFV and instruct passengers to declare such materials or indicate whether they have visited any farms recently (30 days) to the biosecurity officer. Passengers can dispose of their food items in designated bins. Non-compliance shall be penalized.

2. Strengthen biosecurity procedures to ensure all baggage is scanned upon arrival and manual searches performed when suspect items are observed.

3. Ensure appropriate disposal of confiscated products through the incinerator.

4. Encourage households and restaurants to separate meat from vegetable waste and ban the supply of meat leftovers to pig owners.

[1] For the purpose of this report, the acronym 'PICs' refers to the eight project countries: the Cook Islands, Fiji, Federated States of Micronesia, Kiribati, Samoa, Solomon Islands, Tuvalu and Vanuatu.

5. Implement an education program to inform farmers across all PICs about the risks of feeding contaminated swill to pigs and the importance of boiling swill for at least one hour to eliminate the virus.
6. Increase awareness of pig owners and villagers about the ban on meat waste feeding, especially pork meat.
7. Educate stakeholders on ASF clinical signs and prompt reporting by pig owners/animal workers/public of signs of disease to the Ministry of Agriculture.
8. Promote and strengthen farm biosecurity practices, i.e., proper fencing of pigs, apply appropriate hygiene and sanitation measures.
9. Regularly review the ASF status of countries where pork and pork products are being imported and do not accept products from countries with uncontrolled ASF outbreaks in commercial pigs.
10. Prepare emergency response plan for ASF with implementation and financial plan. For those countries that already developed the plan, increase the awareness and provide trainings to relevant officers.
11. Strengthen biosecurity legislations/regulations to include ASF and other TADs preventive and response measures, including the ability to fine companies/people who break these regulations where they exist.
12. Encourage a multi-sectoral and multidisciplinary approach (One Health) to address biosecurity threats of ASF and other TADs.

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Abbreviations and acronyms

ASF	African swine fever
ASFV	African swine fever virus
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
PCR	polymerase chain reaction
PICs	Pacific Island countries
FAO RAP	FAO Regional Office for Asia and the Pacific
FAO SAP	FAO Subregional Office for the Pacific Islands
SEA	Southeast Asia
SPC	The Pacific Community
TAD	transboundary animal disease
WAHIS	World Animal Health Information System
WOAH	World Organization for Animal Health

1. Introduction

1.1.1 BACKGROUND

African swine fever (ASF) is a highly infectious transboundary animal disease affecting pigs (Costard *et al.*, 2013). ASFV-infected pigs develop severe lethargy, diarrhoea, or acute hemorrhagic fever, which typically results in death (Gabriel *et al.*, 2011; Gallardo *et al.*, 2017). After introducing ASF to Georgia in 2007, the disease has spread to nearly every Eastern European country (Rowlands *et al.*, 2008). The situation worsened in 2018 as ASF was reported in China and rapidly spread to other adjacent Asian countries, causing the loss of more than 6.7 million pigs, mostly as pre-emptive culling (OIE, 2020). The movement of the ASFV into the Asia Pacific region poses a risk of ASF introduction to Pacific Island countries (PICs). An outbreak of ASF in PICs would result in high levels of pig mortality which would significantly affect food security in the country as most pigs are kept for subsistence. In addition, the costs associated with safely disposing of animals that die because of the disease and the slaughter and disposal of healthy animals to control the outbreak would be significant.

1.1.2 MISSION ACTIVITIES

In 2020, a pilot project was initiated by the FAO Subregional Office for the Pacific Islands (FAO SAP) based in Apia, Samoa, in close collaboration with the FAO Regional Office for Asia and the Pacific (FAO RAP) to assess the risk of ASF introduction to Samoa. The mission was completed by EpiCentre, Massey University, New Zealand. Two consultants visited the country to interview government agencies, farmers, and stakeholders and delivered a risk assessment report. Given the lack of import risk assessment of ASF in other Pacific countries, the project's scope was expanded to cover the risk for other PICs, including the Cook Islands, the Federated States of Micronesia, Fiji, Kiribati, Solomon Islands, Tuvalu and Vanuatu.

Due to the travel restriction caused by the COVID-19 pandemic, EpiCentre consultants couldn't visit other PICs. Therefore, instead of face-to-face interviews administered by EpiCentre consultants, questionnaires were developed based on experience in Samoa and administered by the local officers in respective countries. The questionnaires were used to collect information from the following agencies from project countries:

- Livestock Department/Ministry of Agriculture
- Biosecurity/Quarantine services
- Customs office
- Ports authority/Marine office
- Airport authority office.

The information collected aimed to aid our understanding of the roles and responsibilities of various government agencies and gather information on factors influencing the occurrence and spread of ASF for import risk analysis. For data relating to the introduction pathway, the focus was on what happened before the travel restrictions imposed due to the COVID-19 pandemic.

The survey also included representative pig farmers (commercial/subsistence) and traders to understand the farming practices and biosecurity measures in commercial/subsistence pig farms and local pork supply. The national coordinator also conducted spot checks for imported and local pork products in the local supermarket in respective countries.

2. African swine fever (ASF)

2.1.1 ASF VIRUS

ASFV is a double-stranded DNA arbovirus of the family of *Asfarviridae*. ASFV isolates could be classified into eight serogroups, and recent genetic research has demonstrated that the virus can be categorized into 23 geographically related genotypes with numerous subgroups (Beltran-Alcrudo *et al.*, 2017). ASFV genotype is classified via the variability of a segment in the VP-72 gene. The phenotypic analysis is used to identify the source of outbreaks. No distinctive differences in the virulence between different genotypes have been reported.

ASFV can be isolated from the blood, faeces, urine, and nasal/ocular/vaginal excretions of infected pigs up to at least 70 days of infection (de Carvalho Ferreira *et al.*, 2012). Depending on the environmental conditions, the virus can also still be isolated from the carcasses of infected pigs and the soil of the deathbed for up to several months (Fischer *et al.*, 2020; Zani *et al.*, 2020). In addition, the virus can survive in fresh, salted, dried, and frozen meat for months to years (Table 1).

Table 1. Expected survival time of African swine fever virus in various conditions

Product	Survival time (days)
Meat (boned, de-boned, ground)	105
Salted meat	182
Cooked or canned meat	0
Dried meat	300
Smoked meat	30
Chilled meat	110
Frozen meat	1000
Fat or skin	300
Offal	105
Urine	15
Faeces	11

Source: adapted from **Adkin, A., Coburn, H., England, T., Hall, S., Hartnett, E., Marooney, C. & Wooldridge, M.** 2004. *Risk assessment for the illegal import of contaminated meat and meat products into Great Britain and the subsequent exposure of GB livestock (IIRA): foot and mouth disease (FMD), classical swine fever (CSF), African swine fever (ASF), swine vesicular disease (SVD)*. New Haw: Veterinary Laboratories Agency, **Anonymous**. 2010. *Scientific Opinion on African Swine Fever.* EFSA Journal, 8(3): 1556. https://doi.org/10.2903/j.efsa.2010.1556 and **Davies, K., Goatley, L.C., Guinat, C., Netherton, C.L., Gubbins, S., Dixon, L.K. & Reis, A.L.** 2017. *Survival of African Swine Fever Virus in Excretions from Pigs Experimentally Infected with the Georgia 2007/1 Isolate*. Transboundary and Emerging Diseases, 64(2): 425–431. https://doi.org/10.1111/tbed.12381

Transmission of ASFV could occur via direct contact with infected animals, consumption of contaminated pork or material, fomites (e.g. cloths, trucks, feeds), and soft tick vectors of *Ornithodoros* spp. (Dixon et al., 2020). In ASFV-free countries, the virus could be introduced through the movement of infected wild boars or contaminated pork products carried by passengers (Kim *et al.*, 2019; Sauter-Louis *et al.*, 2021).

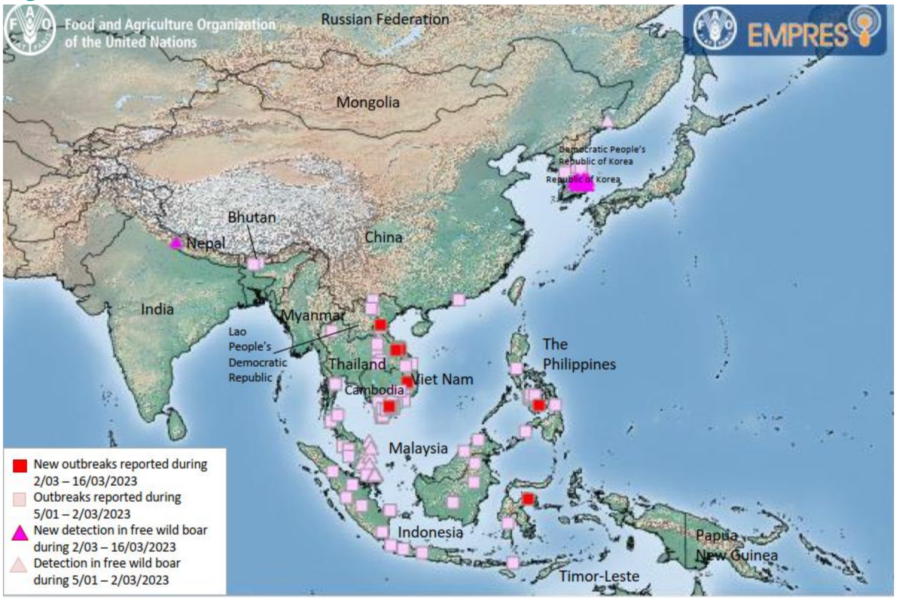
There are no treatments for ASF or vaccines to prevent the spread of ASF. The only way to contain an outbreak of ASF is the immediate culling of pigs on infected farms and those near or in contact with infected farms (OIE, 2019). Therefore, rapid and reliable detection is required for the timely implementation of the control measures. Early detection relies on immediate reporting when pigs are observed to have clinical signs consistent with ASF (i.e. dermal haemorrhages, fever, diarrhoea, bleeding from orifices, high mortality) and rapid testing of dead pigs. A PCR based on the VP-72 gene is the test of choice for early detection in peri-acute, acute or subacute ASF cases. However, PCR cannot confirm infectivity but can confirm the presence and quantitative information (Beltran-Alcrudo *et al.*, 2017).

2.1.2 ASF SITUATION

ASF had been an endemic disease only in Africa until 1957 when the first transcontinental case occurred in Portugal (Boinas *et al.*, 2011). ASF then spread to other European and American countries. In 1995, except for Sardinia in Italy, the regions were declared free of ASF (Dixon *et al.*, 2020). Almost two decades later, another introduction of ASFV to Europe was reported from Georgia in June 2007 (Rowlands *et al.*, 2008). ASF quickly spread to the Caucasus region (Beltrán-Alcrudo *et al.*, 2009) and persisted in the continent mainly via the "wild boar–habitat cycle" that the transmission of ASF occurs directly between wild boars and indirectly through carcasses in the habitats (Chenais *et al.*, 2018). Since its re-introduction in 2007, ASF has transmitted to other European countries, including Ukraine, Belarus, Poland, Republic of Moldova, Czechia, Romania, Hungary, Bulgaria, Belgium, Slovakia, Serbia, Greece, Lithuania, Estonia, Italy, Latvia, and Germany (OIE, 2020; Sauter-Louis *et al.*, 2021; Schulz *et al.*, 2019).

In 2019 ASFV was reported in China and has rapidly spread to other Asian countries, most likely via the illegal importation of pig meat from affected countries (Schulz *et al.*, 2019). Since ASFV was reported in China, outbreaks have been reported in 17 other countries in the Asian Pacific (see Figure 1; FAO, 2023). Affected countries implemented control measures, such as pre-emptive culling and movement restriction. Between 2018 and 2020, nearly 7 million Asian domestic pigs were culled to prevent the spread of ASF. The Ministry of Agriculture and Fisheries of Timor-Leste announced the culling of 100 000 pigs after the confirmation of ASF in September 2019. In January 2022, an outbreak of ASF was reported in Thailand, and the government allocated USD 17.3 million to control the disease spread. Due to the geographical proximity to Thailand, the Cambodian government restricted any importation of pigs from its neighbouring countries. In addition, Nepal reported its first cases of ASF in May 2022 (Subedi *et al*., 2022) and Singapore in February 2023 (FAO, 2023). ASF outbreaks and followed control measures have severely affected national food security and livelihood, especially in poor rural families in many Asian countries. However, ASF control was largely ineffective due to a lack of technical or financial resources.

Figure 1. Current situation of ASF in Asia as of March 2023



Source: ***FAO****. (2023) ASF situation in Asia update. http://www.fao.org/ag/againfo/programmes/en/empres/ASF/situation_update.html#*

3. Pacific Island countries

3.1.1 GENERAL PROFILE

The PICs are located in the Pacific Ocean between Asia and the Americas (Figure 2). They are divided into three subregions:

- Melanesia: Located in the western Pacific, includes Papua New Guinea, Solomon Islands, Vanuatu, Fiji, and New Caledonia
- Micronesia: Located in the central Pacific, includes Kiribati, the Marshall Islands, the Federated States of Micronesia, Nauru, and Palau.
- Polynesia: Located in the eastern Pacific, includes Samoa, Tonga, Tuvalu, the Cook Islands, Niue, French Polynesia, Pitcairn Islands, and the Wallis and Futuna.

The PICs face a number of common challenges, including limited land and natural resources, vulnerability to climate change and natural disasters (Bakare *et al.*, 2020), and high transportation costs. However, they also have unique cultural identities and rich histories and work towards sustainable development and economic growth.

The demographic of PICs varies depending on the specific country, but generally, these countries have relatively small populations and land areas compared to other countries. Additionally, PICs are known for their ethnic and cultural diversity. Agriculture plays an important role in the economy of PICs, although the specific agricultural practices and areas vary depending on the country. Usually, PICs rely on n the cultivation of crops such as bananas, taro, yams, and sweet potatoes, which are important food sources for the local populations. In addition, livestock production (including raising pigs, chickens, and cattle) and Fishing are crucial sources of income and food for many Pacific Island countries. A summary of population, land area and GDP of eight project countries is provided in Table 2.

Figure 2. Location of the PICs

Source: UN. 2020. Geospatial Clear Map [online]. [Cited 26 April 2022]. geoservices.un.org/Html5Viewer/index.html?viewer=clearmap

The boundaries and names shown and the designations used on these map(s) do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries. Dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Table 2. Population, land area and GDP of project countries.

PICs	Population (approx.)	Land area (km^2)	GDP (USDM)
Cook Islands	17 000	240	252
Fiji	925 000	18 270	4 907
Federated States of Micronesia	113 000	700	404
Kiribati	129 000	810	204
Samoa	219 000	2 780	752
Solomon Islands	708 000	27 990	1 655
Tuvalu	11 000	30	63
Vanuatu	319 000	12 190	944

Source: **UNCTAD.** 2021. UNCTADstat - General Profile. In: UNCTADstat Cited 31 March 2023. https://unctadstat.unctad.org/countryprofile/en-GB/index.html

3.1.2 PIG SECTOR

The livestock sector is important to the country's economy and food security. The sector comprises small-scale subsistence farmers who raise animals such as pigs, chickens, and goats for consumption and sale in local markets.

Pigs are the most important livestock species in the PICs, mainly raised in rural areas. Pigs are used for various purposes, including food, ceremonial activities, and as a source of income through sales (SPC, 2007). The production of pigs in the PICs is often done in a traditional and non-commercial way, with little or no inputs such as improved feeds, breeds, biosecurity and veterinary care.

A brief summary of the pig sector in project countries is provided below, and Table 3.

Cook Islands:

- The 2011 Agricultural census reported nearly 14 000 pigs in ~1 400 households, with 85 percent on Rarotonga and southern islands.
- Majority of households (60 percent) keep less than ten animals, and less than 6 percent keep over 30 pigs.
- Pig production is mainly subsistence.
- Local feeds such as coconut and swill are being used, with some pig farmers reporting using swill without heat treatment.
- Limited commercial feeding with all processed feeds imported mainly from New Zealand.

Fiji:

- The 2020 Agricultural census reported over 58 000 pigs in 8 800 households.
- Pig production is mainly subsistence, with a mean number of pigs per household at 6.8.
- Larger pig farms use indoor pens, while subsistence farms allow free-roaming or use certain enclosures.
- Commercial farms only use commercial premix feeds, while subsistence farms may use food waste. All surveyed farms reported heat treatment of swill.

Federated States of Micronesia

- Pigs are raised for self-consumption, customary obligation and have ceremonial value, particularly in funerals.
- Around 30 000 pigs are farmed in 6 322 households, with the majority in Pohnpei (55.4 percent), followed by Chuuk (28.5 percent), Yap (9.5 percent), and Kosrae (6.6 percent).
- 65 percent of households keeping pigs have them in fenced enclosures or buildings, while the rest allow them to roam freely, with this practice being most common in Chuuk state.
- Commercial feed is purchased by 60 percent of households in Pohnpei and 40 percent in Kosrae, while less than 5 percent in Yap and Chuuk states purchase feed and mainly use food waste. Some pig farmers reported using swill without heat treatment.

Kiribati

- The 2020 census recorded 41 507 pigs, including 39 507 local pigs and 1 959 crossbreed pigs.
- Total pig populations were distributed between urban (46 percent) and rural islands (54 percent).
- Pig operations with more than 20 animals account for less than 0.01 percent of operations.
- Pigs are largely tethered or penned in small pens made of various materials at the back of houses or along the seashores.
- Approximately 20 percent of households raising pigs in the urban area are very close to neighbours.
- Pigs are fed a diet of copra meal, coconut and food waste, and some pig farmers reported using swill without heat treatment.
- There is evidence of feral pigs in Kiribati, likely consisting of escaped domestic pigs, though the free roaming of pigs is rare due to limited land space.

Samoa

- A recent survey estimated 168 697 pigs, roughly half located in each of the main islands of Upolu and Savaii.
- Most pigs are of indigenous breed and reared in a traditional small-scale production system, with 55 percent free-range and 45 percent confined herds.
- A small number of producers are classified as commercial by APHD, defined as having more than two sows and roofing over the pig shelter.
- Only 1 percent of pig holdings purchase imported pig feed from New Zealand, while the majority use a mix of coconuts and food waste for their diet. The surveyed farms practised heat treatment for swill.
- Wild pigs are present in the mountainous areas of the two main islands, and some free-range domestic pigs have become wild.

Solomon Islands

- A recent agriculture survey in 2017 estimated 149 651 pigs in 32 912 households in the Solomon Islands
- Production of pigs is often traditional and non-commercial.
- Guadalcanal and Malaita have the highest number of pigs (58 percent).
- Pigs are fed a diet of copra meal, coconut, and food waste (swill), and all survey farms reported cooking swill.
- Pigs are largely penned or tethered with a tree. Some farmers allow their pigs to roam in their farm area.
- Trading of both live pigs and pork to the neighbouring Islands is common.

Tuvalu

- The total pig population in Tuvalu was 10 894, according to the 2017 census.
- The majority of pig population is in Funafuti (35 percent), followed by Vaitupu (15.4 percent) and Nanumea (14.2 percent).
- Over 75 percent of households raised pigs on average.
- Some domestic pigs have become feral, but the size of the feral pig population is unknown.
- Most pigs in Funafuti are confined to the communal pig-rearing area, while approximately 8 percent of households reported not having any housing, likely in Nanumea.
- Most pigs are fed a diet of coconut and food waste (swill), and some farmers reported cooking swill over an open fire, but some did not heat treat the swill before feeding.
- A small number of households purchase pig feed imported from Australia as a supplement to diet.

Vanuatu

- In 2007, 86 694 pigs were raised in 17 981 households, with an average of five pigs per household. The number of pigs reared in the country has since increased, with variations between provinces.
- Penama province saw a doubling in the number of pigs due to increased demand for local ceremonies involving pig slaughter.
- Sanma province saw limited growth in the number of pigs due to religious beliefs and urbanization
- Most pigs are fed a diet of coconut, copra meal, taro, cassava and food waste (swill). Some farmers reported cooking swill, but some did not heat treat the swill before feeding.

Examples of pig rearing in confined area in PICs

Examples of free-roaming and tethered pigs in PICs

Table 3. Total number of households (HH), HH raising pigs, pig population and practices in project countries.

PICs	Total HH	HH raising pigs	Pig number	Pig rearing practice	Feeding practice	Reference
Cook Islands	4 593	1 400	14 000	100 percent confined (tethered, pen)	Coconut, swill*, commercial feed	(Ministry of Agriculture, 2014)
Fiji	193 134	8 303	58 420	Free-roam, confined (no percent data)	Swill, commercial feed	(Ministry of Agriculture, 2021)
Federated States of Micronesia	15 545	6 322	30 000	35 percent free-roam and 65 percent confined	Swill+, commercial feed	(Federated States of Micronesia Statistics Division, 2019)
Kiribati	20 354	14 515	41 507	100 percent confined (tethered, pen)	Copra meal, swill*, commercial feed	(Kiribati National Statistic Office, 2022)
Samoa	28 119	12 654	168 697	55 percent free-roam and 45 percent confined	Coconut, swill, commercial feed	(Samoa Bureau of Statistics, 2016)
Solomon Islands	111 117	32 912	149 651	100 percent confined (tethered, pen)	Coconut, copra meal, swill, commercial feed	(Solomon Islands National Statistic Office, 2019)
Tuvalu	1 626	1 242	10 894	8 percent free-roam (Nanumea) and 92 percent confined	Coconut, swill*, commercial feed	(Tuvalu Central Statistics Division, 2021)
Vanuatu	47 373	17 981	86 694	100 percent confined (pen)	Coconut, copra meal, swill*	(Vanuatu National Statistics Office, 2008)

*Note: *Some surveyed farmers reported using swill without heat treatment.*
Source: elaborated by the authors

Examples of food scraps and swill cooking in PICs

3.1.3 PORK AND PORK PRODUCTS

Pork and pork products are a significant part of the Pacific Island cuisine and culture. In PICs, pork is consumed on special occasions and celebrations, such as weddings, funerals, and other important events. Imported pork products are commonly found in PICs, as local pork production is unable to meet the demand for pork. Most of these imported pork products come from Australia, New Zealand, the United States of America and European countries such as Spain, Germany, Denmark, Italy and Ukraine. They may include fresh or frozen pork cuts, canned pork, sausages, and other processed pork products. During the past few years, the importation of pork products has been subject to strict regulations to prevent the introduction and spread of diseases such as African swine fever. As a result, only pork products from ASF-free countries are allowed.

A brief summary of pork and pork products in project countries is provided below and in Table 4. In addition, a typical pork value chain in PICs is shown in Figure 6.

Cook Islands

- Nearly 6 500 pigs were slaughtered or sold alive for self-consumption or sale annually.
- Around 80 percent of the pigs were sold as fatteners weighing between 60 and 100 kilograms.
- There are no abattoir or commercial home kill services, so household members slaughter the pigs near where they were raised.
- Pigs and pork are sold directly, mostly to neighbours for customary or social functions. A small portion of the product is sold to local restaurants.
- Local supermarkets sell pork meat, but it's all imported from the United States of America, New Zealand, and Spain.

Fiji

- Around 8 880 pigs were sold or given away alive, slaughtered at home, or sold directly to abattoirs across the Republic of Fiji annually.
- 48 percent were sold or given away alive, 34 percent were slaughtered at home, and 19 percent were sold directly to abattoirs.
- Pigs slaughtered at home were for self-consumption or customary/social functions like weddings, funerals, or feasts.
- Pigs sold directly to abattoirs were sold as fresh pork in specific butcher shops and supermarkets through the Fiji Meat Industry Board.
- Supermarkets in Fiji also sell imported pork and pork products, mainly from New Zealand and Australia. Some pork products are imported from European countries, i.e. Spain, Italy and Ukraine.
- The amount of imported pork meat reported by interviewees ranged from less than 300 tonnes to more than 770 tonnes annually before COVID-19.

Federated States of Micronesia

- Approximately 14 500 adult pigs are killed each year. 70 percent of pigs are killed for self-consumption or customary/social obligation.
- Pigs are commonly slaughtered at home (live weight of 25–75 kg).
- Pigs not killed for self-consumption or social obligation are sold to neighbors or pig traders.
- Pig trade is more active in the state of Yap.
- Pork products are imported mainly from the United States of America.
- Most of the imported pork products are consumed by households, with some distribution to restaurants.

Kiribati

- Local pork production has increased due to increasing population and disposable income.
- Pigs are slaughtered by someone in the household and sold directly to neighbours for customary or social functions.
- A small proportion of the product is sold to local restaurants.
- Pork meat is available at local supermarkets, but none comes from domestic production.
- Pork products in supermarkets are imported mainly from Australia, New Zealand, united States of America and Fiji (up to 2 900 tonnes per year)

Samoa

- 60 percent of pigs in the pig production system are for cultural purposes or household consumption.
- Pigs are commonly slaughtered at home or on-farm at 12 weeks of age (Size 2) and traditionally cooked in an oven for ceremonial occasions and festivities.
- Pork contributes to food security and nutrition, while live pigs are kept for financial security and as a source of cash.
- Around 25 000 pigs are sold annually via direct sale or retail, generating a total revenue of USD 1.2 million/year.
- In 2018, Samoa imported 360 tonnes of pork products, mainly for local consumption and the tourist sector.

Solomon Islands

- Around 54 000 pigs were disposed of annually. 62 percent (33 978) were sold for income, while 16 percent (8 486) were disposed of for social and cultural purposes. The remaining 22 percent (12 024) were disposed of for consumption.
- Pigs are typically slaughtered on farms (live weight of 90 kg).
- From 2016 to 2018, the average annual importation of pork was 79 tonnes.
- The Biosecurity Act 2013 and Biosecurity Regulations 2015 only allow importing of pork products from Australia.
- Imported meat and animal products are significant for meeting local demand for meat consumption.

Tuvalu

- Pigs are raised mainly for household consumption or cultural purposes.
- Pigs are usually slaughtered at a live weight of 25–50 kg.
- Pigs are typically slaughtered at home or on farms and used for ceremonial occasions and festivities.
- Tuvalu imports an unknown quantity of pork meat and products for local consumption and supply to local restaurants. All imported pork products are certified by Australian standards.

Vanuatu

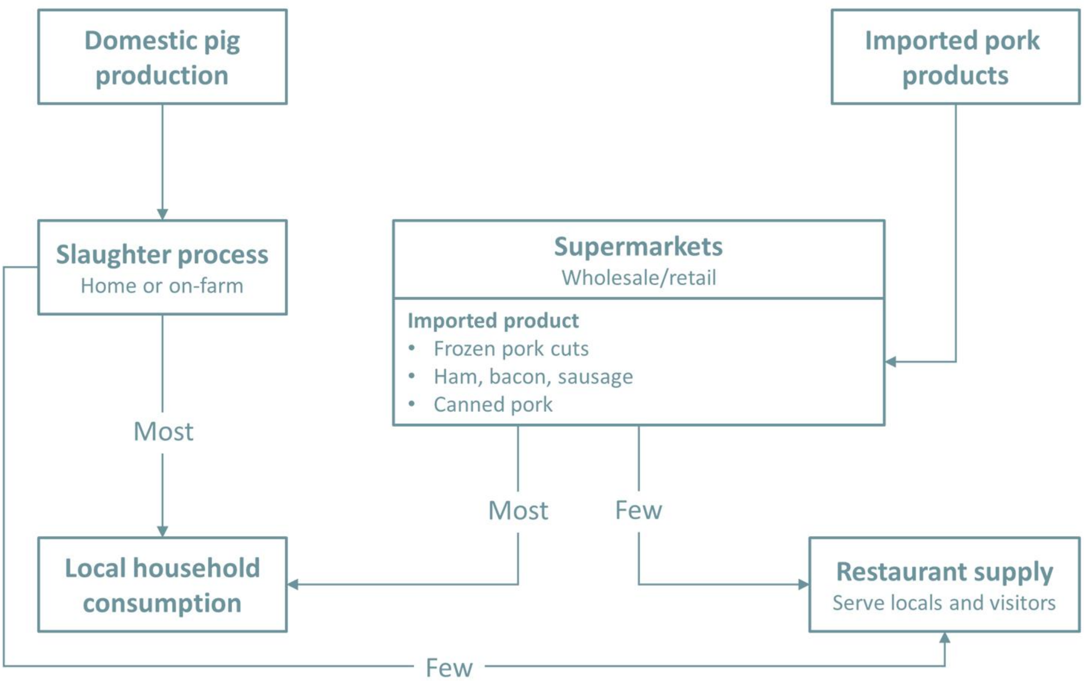
- Pigs are commonly slaughtered at home (live weight of 150–200 kg).
- Vanuatu imports an unknown quantity of pork meat and products for local consumption and supply to local restaurants.
- The imported pork products include retail cuts, bacon, dumpling, canned pork, etc.
- All pork products are imported from Australia and New Zealand and certified by their standards.

Table 4. Local and imported pork products in project countries.

PICs	Local pork product		Import pork product		
	Slaughter practice	Slaughter weight	Type	Volume/year (tonnes)	Source
Cook Islands	At home/farm	60–100 kg	Pork cuts, ham, shoulder, canned	141	United States of America, New Zealand, Spain
Fiji	At home/farm (81 %)/abattoir (19 %)	80–100 kg	Pork cuts, ham, bacon, sausage, canned	300-770	Australia, New Zealand, Spain, Italy, Ukraine
Federated States of Micronesia	At home/farm	25–75 kg	Pork cuts, ham, sausage, and cured or canned	NA	United States of America
Kiribati	At home/farm	30–50 kg, 150–250 kg	Pork cuts, ham, shoulder and canned	2 900	Australia, New Zealand, United States of America, Fiji
Samoa	At home/farm	20 kg	Pork cuts, ham, shoulder, sausage, canned	360	United States of America, Denmark, Germany
Solomon Islands	At home/farm	90 kg	Frozen pork cuts, ham, shoulder, bacon, canned	79	Australia
Tuvalu	At home/farm	25–50 kg	Pork cuts, ham, shoulder, sausage, canned	NA	Australia
Vanuatu	At home/farm	150–200kg	Pork cuts, bacon, dumplings, canned	NA	Australia, New Zealand

Source: elaborated by the authors

Figure 6. The value chain of pork products in Pacific Island countries



Source: elaborated by the authors.

An example of a pig slaughter area on a farm in PICs

Imported pork product examples in PICs

3.1.4 ROLES OF AGENCIES FOR PREVENTING AND RESPONDING TO AN ASF OUTBREAK

Securing the border of the PICs against invasive pathogens is a task of the Biosecurity services under the Ministry of Agriculture in each country. The Biosecurity services liaise with Customs, Airport authority and Port authority/Marine offices. They are responsible for preventing the introduction of all harmful insects, pests, and diseases through passenger arrival, cargo, and post. The importation of live animals or meat products to the PICs requires a Biosecurity Import Permit. Also, before arrival, any imported live animals must undergo a pre-departure health treatment specified in the Import Health Standard. When found, illegally imported animals or animal products, including those without the permit, are confiscated for incineration and burial. However, during interviews, customs and biosecurity officers reported manually screening baggage/cargo for those who declared to detect prohibited items. Some PICs, i.e., the Cook Islands, Fiji and Samoa, also applied x-ray inspection of passengers. In the Solomon Islands, x-ray machines were recently donated by the Australian Border Force and Japan International Cooperation Agency to enhance the country's capability to safeguard its borders against biosecurity risks.

There is a shortage of qualified veterinarians operating in the PICs, with qualified professionals only present in Fiji, Solomon Islands, Tuvalu and Vanuatu. In the remaining project countries, veterinary paraprofessionals/extension officers routinely provide simple treatments such as deworming and diagnosis of minor diseases.

In an animal disease emergency like ASF, the Ministry of Agriculture sanctions provisional measures to verify the outbreak and control its spread. The legal basis for declaring a biosecurity emergency in each PICs is the Biosecurity/Disaster Management Act. Should an ASF outbreak occur, the Ministry/Disaster Management Office has the legal powers to coordinate the response involving several government agencies. In addition, the Act allows other parties, such as Police, to exercise reasonable force to ensure compliance. However, no standard of procedure is prepared against an outbreak of ASF in the PICs. Recently, Fiji, Kiribati, Samoa, Solomon Islands and Vanuatu have scaled up their preparedness efforts against any possible outbreak of ASF and developed their ASF emergency response plan, with support from the FAO or the Pacific Horticultural and Agricultural Market Access Program (PHAMA Plus).

During an ASF response, the relevant government office in each PIC would declare a biosecurity emergency under their Biosecurity Act and require the Director to undertake the most appropriate measures. The Director can require the Biosecurity officers to conduct the following activities:

- Surveillance of animal populations for ASF outbreaks;
- Responding to public enquiries about sick animals, investigation and organization of property access for sample submission and submission of samples for laboratory testing;
- Raising awareness amongst communities on the impacts of ASF outbreaks on livelihoods;
- Risk reduction and management of outbreaks;
- Prohibition of animal movements;
- Prohibition of the distribution, sale or use of any animals, animal products or animal-related items;
- Slaughter of animals for disease control purposes to prevent the spread of ASF, instructions for the disposal of animal carcasses;
- Implementation of official control programs, including disinfection and eradication measures.

4. Import Risk Analysis

The methodology used in this mission follows the WOAH (formerly known as OIE) import risk analysis framework (OIE, 2010) and the New Zealand Biosecurity Risk Analysis guidelines (Biosecurity New Zealand, 2006). The terminology used for risk attributes and descriptors is provided in Table 5. The import risk analysis process is shown in Figure 9.

4.1.1 HAZARD IDENTIFICATION

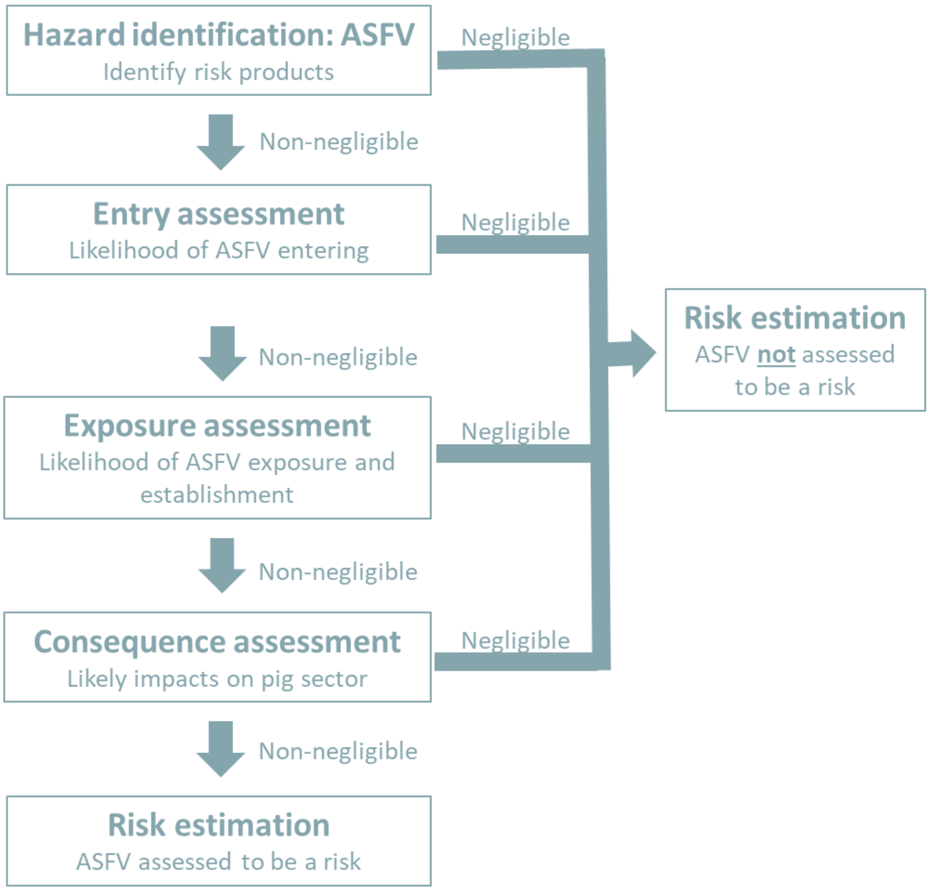
ASFV is known to be exotic to the PICs and identified as a potential hazard. Thus, the main goal for this step is to identify risk products/items from ASF-affected countries that could be contaminated with ASFV and enter any state of the PICs. According to the latest WOAH World Animal Health Information System (WAHIS), ASF was reported in Africa, the Eastern part of Europe, Russian Federation and 18 countries in Asia, including China, Mongolia, Viet Nam, Cambodia, Democratic People's Republic of Korea and Republic of Korea, Lao People's Democratic Republic, Myanmar, The Philippines, Timor-Leste, Indonesia, Papua New Guinea, India, Malaysia, Bhutan, Thailand, Nepal and Singapore (FAO, 2023; OIE, 2020). ASFV can be transmitted directly or indirectly via pig-to-pig, feed-to-pig and fomites-to-pig (Guinat et al., 2016). Therefore, it was assumed that pork meat products, pig feed, and contaminated fomites from these regions would pose a non-negligible risk of ASF introduction into the PICs.

Table 5. Terminology for Risk Attributes and Descriptors (Biosecurity New Zealand, 2006)

Risk Attributes	
- Negligible	Not worth considering; insignificant
- Non-negligible	Worth considering; significant
Risk Descriptors	
- Very Low	Close to insignificant
- Low	Less than normal level
- Medium	Around normal level
- High	Extending above normal level
- Very high	Well above normal level

Source: **Biosecurity New Zealand.** 2006. Risk Analysis Procedures, Version 1. Cited 31 May 2022. www.mpi.govt.nz/dmsdocument/2032/direct

Figure 9. Import risk analysis process



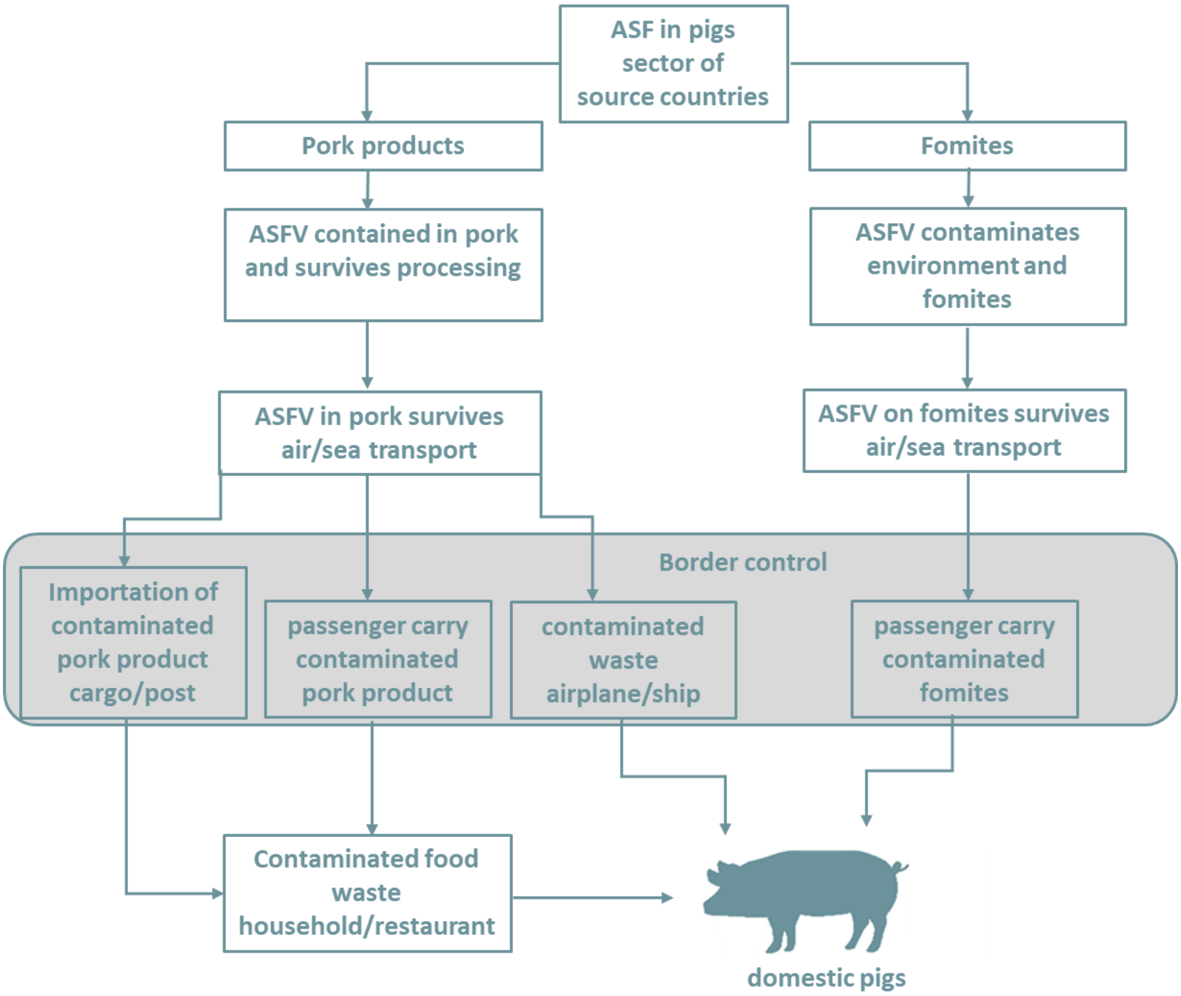
Source: elaborated by the authors.

4.1.2 ENTRY ASSESSMENT

The PICs are located far from their nearest neighbour except for the Solomon Islands, which has a porous border between its Western province and Bougainville Island of Papua New Guinea. The entry of ASFV into most of the PICs would be restricted to air and seaports. Contaminated pork meat products and fomites from passengers could introduce ASFV into the country. Figure 10 summarises the potential pathway for ASFV to enter the PICs. The importation of live pigs into the PICs is rare, and the record only showed previous imports from Australia and New Zealand, so this pathway was not examined. Additionally, all imported animals must undergo pre-departure health treatments specified by the Import Health Standard of PICs.

Pork meat and meat products, such as pork cuts, ham, shoulder, and pork luncheon meat, are mainly imported from the United States of America, Australia, and New Zealand. So far, no ASF outbreaks have been reported in those countries. However, some pork products in Fiji are imported from European countries, i.e. Spain, Italy and Ukraine. ASF has been detected in wild pigs in Italy and domestic pigs in Ukraine (Iscaro *et al*., 2022; APHA, 2022). Therefore, legally imported pork products may pose a low to medium risk of ASFV introduction to Fiji. For other PICs, it is less likely for ASFV to be introduced through pork products imported through legal channels.

Figure 10. The risk pathway of African swine fever virus into the Pacific Island countries



Source: elaborated by the authors.

ASFV could be introduced into the PICs via passengers illegally bringing infected pork products upon international arrival. All passengers must fill in arrival cards and declare whether they carry food items. While manually searching arriving passengers' luggage for declared passengers and x-ray inspection of random passengers were prescribed, the process could miss pork products. Unconstrained imports of pork products, either accidentally by tourists from affected countries or intentionally smuggling the products for personal or commercial use, present a continuous threat to ASF introduction (Wooldridge *et al.*, 2006). The Solomon Islands have unique risk pathways that increase the likelihood of ASFV introduction. Unmonitored logging vessels arriving from ASF-infected countries carry frozen pork products for crew ration, while biosecurity services cannot properly investigate an influx of construction workers from Asia. Together, these factors pose a significant threat to the introduction of ASFV into the Solomon Islands.

The ASFV can also be carried on clothing or footwear that could have contact with pigs in the source country. Such risky fomites are not being cleaned and disinfected at arrival. In addition, the virus can persist for several days on fomites, particularly if protected by organic matter (Bellini, Rutili and Guberti, 2016). Therefore, anyone who had contact with an infected area, such as walkers, hunters or farmworkers visiting/returning to the PICs, could bring contaminated fomites into the country. Given the possibility that passengers arriving from ASF-endemic regions cannot be ruled out, international travellers could carry infected pork products or contaminated fomites into the PICs.

International waste originating from airplanes and ships arriving from endemic countries is another important pathway of ASF introduction (Costard *et al.*, 2009). Different maritime transport vessels arrive in the PICs, such as commercial ships with cargo and fishing vessels. Crews and passengers may carry and not declare pork products; containers may be contaminated with viruses, and catering waste may contain contaminated pig meat.

In conclusion, the likelihood of ASFV entry to PICs is non-negligible.

4.1.3 EXPOSURE ASSESSMENT

Pigs could be exposed to ASFV via feeding of leftover pork meat products or through contact with contaminated fomites from ASF-affected countries. From the surveyed farmers, swill feeding practices without heat treatment were reported in 5/8 countries, i.e., the Cook Islands, Federated States of Micronesia, Kiribati, Tuvalu and Vanuatu. As a result, household scraps or food wastes could be contaminated with infected pork meat. In addition, although some pig farmers may cook swill before feeding them to pigs, it is difficult to ensure that traditional cooking over an open fire is sufficient to inactivate the virus. A recent thermal inactivation study of ASFV in swill suggested inactivation times at 70 and 90◦C for 119 and 4 min, respectively (Nuanualsuwan *et al*., 2022).

Feral pigs may play a key role in ASFV exposure. Feral pigs could be exposed to food waste by scavenging food waste with contaminated pork meat products or fomites contaminated by villagers. In addition, the growing feral pig numbers suggest they are apt to compete for food resources, including scraps. It also suggests that there might be more contact between domestic and feral pigs for food waste, which will contribute to the spread of ASFV if the virus is introduced to the country. Accordingly, the likelihood of ASFV exposure is non-negligible.

Since no soft tick vectors (Ornithodoros spp.) are currently present in PICs, this exposure pathway was not investigated.

4.1.4 CONSEQUENCE ASSESSMENT

The spread of ASFV in the pig population is influenced by its rate of transmission and its economic impact, and once it takes hold, it rapidly spreads throughout the population. Pig farms in the PICs usually have little or no biosecurity measures, which is a known risk factor for transmitting ASF. (Sanchez-Vizcaino *et al.*, 2015). Given the trade of pigs as well as crossbreeding with neighbouring farms, is common practice, the lack of basic biosecurity would enhance the horizontal and local spreading of ASF via pig-to-pig contact opportunities. Local traders could also spread ASFV by travelling between villages and collecting live or slaughtered pigs contaminated with ASFV.

The economic and social consequences of an outbreak in PICs will be significant. In all PICs, the livestock sector is important to the country's economy and food security. Pigs also have significant cultural importance in many of the PICs. Therefore, we would expect an outbreak to impact the affected area significantly.

Due to the absence of vaccination, rapid detection and timely implementation of control measures, such as pre-emptive culling or fencing, could be one of the most effective ways to prevent the spread of ASF (OIE 2019; Han *et al.*, 2021). In the PICs, in the case of an ASF outbreak, it is speculated that a timely response to prevent the spread of ASF may not occur. Most project countries have no active/passive surveillance system for animal diseases and no capacity to manage/control/contain an animal disease outbreak. In addition, feral pigs are known to be a risk factor for ASF sustainability (Mur *et al.*, 2016) as these animals are at high risk of contact with household food waste and wild pigs. Therefore, feral pigs could pose an additional risk of ASF spread in the PICs.

Pigs are an integral component of the agriculture of the PICs. They have cultural values and provide food security, high-protein nutrition, and financial assets. The socio-economic consequences of introducing and establishing ASF for the PICs pig sector must be considered extreme. In the event of an ASF outbreak, the rapid slaughter of pigs and proper disposal of pig carcasses are required to control the disease (OIE, 2019). The mortality and mass culling could substantially reduce pig numbers and limit pig meat supply to the local restaurant. The destruction of large numbers of pigs would cause significant socio-economic losses and threaten food security, culture, and livelihood in the PICs.

In conclusion, the socio-economic consequences of an ASFV introduction were assessed to be very high, thus non-negligible.

4.1.5 OVERALL RISK ESTIMATION

The likelihood of an ASFV introduction and its exposure were regarded as non-negligible. The consequences of ASFV spread and its economic impact are considered very high and non-negligible. Therefore, ASF is considered to pose a risk to the PICs.

5. Discussion

African Swine Fever (ASF) is a highly contagious viral disease that affects domestic and wild pigs. In the Pacific Island community, preventing and managing an ASF outbreak will pose many unique challenges. The risk assessment considers the likelihood of introduction, exposure, establishment and consequences. In the discussion, we discuss issues as they relate to the entry, exposure and consequence assessment.

Conducting an entry assessment is essential in identifying the likelihood and relative importance of potential pathways for African Swine Fever (ASF) introduction across the Pacific Island Countries (PICs). The key pathways for virus entry include contaminated fomites, importation of pork meat or pork products contaminated with the viable virus via air or sea, and waste disposal at sea and airports. While fomite spread cannot be ruled out, it is considered the least important pathway for ASF introduction in PICs. The importation of contaminated products and waste disposal are considered the most significant pathways for ASF introduction.

Currently, all PICs legally import pork products from ASF-free countries, except Fiji, which imports a small amount from Italy and Ukraine, where ASF has been reported in wild boar and domestic pigs, respectively. However, interviews in the Solomon Islands revealed an illegal importation pathway for pork meat. Unmonitored logging vessels arriving from ASF-infected countries carry frozen pork products for crew ration and workers at the camps. Anecdotal evidence suggests that waste is also left at logging camps.

Regarding incoming passengers, all PIC countries require travellers to fill in arrival cards and declare whether they carry food items. Despite this, some people may still attempt to smuggle in products. While x-ray inspection of all incoming passengers is key to detecting illegal products, some countries, such as Kiribati, Tuvalu and Vanuatu, do not have x-ray machines, which increases the risk of ASF introduction. While the Solomon Islands have x-ray machines, the upcoming XVII Pacific Games will pressure personnel and resources.

Although our assessments were conducted during business-as-usual times, the region is prone to natural disasters, especially climate-related events. Natural disasters can change this assessment significantly. The impact of disasters is particularly relevant to the region, as highlighted by the recent natural disaster in Tonga, which prevented us from completing the assessment due to staff being otherwise engaged. Disasters can also increase the likelihood of contaminated pork being imported, as aid may come from ASF-infected countries.

The exposure assessment revealed that if contaminated pork meat or product were to enter the garbage, it would likely be fed to pigs by farmers or scavenged from the rubbish by free-roaming or wild pigs in all PICs. As pigs play a critical role in controlling garbage, it is not practical to prohibit the feeding of waste to them. Therefore, we must consider ways to make this pathway safer.

We recommend that people use two separate waste bins, one for meat and the other for vegetables. The vegetable waste can be fed to pigs, while the meat waste can be fed to dogs. Given that full compliance with this recommendation is unlikely, we suggest implementing a program advising farmers to cook swill. Since few farmers will have thermometers, we recommend a simple message of boiling for one hour.

In the consequence assessment, we considered the likelihood of exposure resulting in an outbreak and the economic, social, and environmental consequences of an ASF outbreak. In all PICs, we would expect a reasonable-sized outbreak if a single pig became infected with ASF because detection would likely be delayed. One reason for the delay in ASF detection is the farmers' lack of awareness of the signs of ASF, leading them to report the event to livestock officers only when the losses are high. Additionally, PICs do not have the capability of a veterinarian or laboratory, so samples must be sent to Australia or New Zealand for testing, leading to further delays in detection. When considering delays, the Solomon Islands is particularly noteworthy, as a likely scenario would be an outbreak in Western Province; given its remoteness, it may take some time to obtain confirmation.

Once an outbreak occurs, it will be challenging to control due to limited resources. For instance, widespread pre-emptive culling would be difficult with available resources. Therefore, control programs may need to focus on slowing the spread rather than eradicating it by fencing. Moreover, disposing of dead and culled pigs to control the spread will be challenging logistically. Burial is not an option in many PICs, as the islands are coral atolls or the water table is high. Hence, pigs will need to be burned, requiring significant fuel that is not always available and must be shipped in.

ASF's economic and social consequences in the Pacific Islands region will be significant, as pigs are a major source of food and income. Furthermore, in many countries, such as Samoa, pigs play a crucial role in cultural events, such as weddings and funerals. Little can be done to limit these consequences except to speed up containment. Therefore, preparedness activities should include agreements to enable the deployment of additional personnel and resources from key international agencies and neighbouring countries to assist.

The baseline risk of ASF introduction across the Pacific Island Countries (PICs) is a significant concern, with the greatest risk in the Solomon Islands, particularly in the Western Province. Additionally, there will be an increased risk in the Solomon Islands in November 2023 when they host the XVII Pacific Games. The event will substantially increase the likelihood of ASF introduction due to the significant influx of visitors and the importance of food for catering. It is crucial to note that the risk of ASF may change in the event of a natural disaster. With resources stretched in response to the disaster and a high probability of food shortage, it is essential to ensure that biosecurity standards are not compromised. Therefore, agencies must support PICs in balancing the competing needs of food security and biosecurity to minimize the risk of ASF introduction during natural disasters. Preparedness activities should consider ways to ensure continued biosecurity measures during and after natural disasters, such as developing emergency response plans and providing resources to manage biosecurity risks effectively.

6. Recommendations

6.1.1 REDUCING THE LIKELIHOOD OF ASF ENTRY

Pork products are the primary means by which ASFV enters the PICs, although there is also a less likely but still significant risk of transmission through contaminated fomites such as boots and gear. These could enter via cargo, package and passenger's luggage. To reduce the likelihood of entry, we recommend:

- Passengers should be instructed to declare food products to the biosecurity officer on arrival or dispose of the product in the designated bins in the arrival hall.
- Passengers should be instructed to declare to the biosecurity officer if they have visited any farms recently (30 days). The Biosecurity services should inspect any clothing or footwear they have with them that was worn on the farm. Dirty clothing or footwear should be disinfected or confiscated.
- To improve compliance, passengers found to not be truthful on their declaration form should be fined.

- Promotional material should be placed in highly visible locations in arrival halls and at baggage carousels of airports to increase awareness of incoming passengers about pork products that can carry ASF and the importance of ASF to the PICs.
- Ensure the practice of disposing of confiscated products in high-temperature incinerators.
- Increase awareness and provide training on ASF prevention, including the importance of biosecurity measures and penalties for non-compliance to relevant stakeholders (Farmers, businesses, the public, Biosecurity services, Customs, Airport Authority and Ports Authority).

6.1.2 REDUCING THE LIKELIHOOD OF ASF EXPOSURE

According to the risk analysis, pigs in the PICs are most likely to contract ASFV through the consumption of meat scraps contaminated with the virus. To address this, the consultants suggest running a public awareness campaign to educate people on the negative effects of ASF and emphasize the importance of not feeding pigs with meat waste. In addition, they should cook food waste thoroughly by boiling for one hour before feeding it to the pigs. Although completely avoiding swill feeding would be ideal, it is not feasible due to the rising cost and limited availability of commercial feed. The awareness campaign should leverage social media, television, radio, printed materials, posters, and meetings to encourage people to separate meat and vegetable waste. Additionally, there should be a consideration for a potential ban on the feeding of meat.

6.1.3 REDUCING THE SIZE OF AN OUTBREAK

Early detection is crucial for preventing the spread of ASF during an outbreak. To achieve this, an effective prevention strategy must include a monitoring and surveillance system that enables timely intervention. Sufficient budget and personnel resources are necessary to motivate early reporting, conduct active disease investigation and control, and provide access to laboratories that can diagnose ASF. The government should provide information to veterinary paraprofessionals and pig owners on how to recognize ASF and promptly report any suspicious cases. Pig farmers should be aware of the signs of ASF and be informed of whom they need to notify. Awareness can be raised through various channels such as social media, TV, radio, printed materials, posters, and meetings with pig farmers.

In the event of an ASF infection, all animals on the infected property, regardless of their condition, must be culled and disposed of properly to prevent further spread. The government should train and equip sufficient personnel for rapid culling, disposal of carcasses, cleaning, and disinfection. To ensure compliance from pig owners, a compensation strategy and adequate financial resources should be allocated for the removal and disposal of affected pig herds as part of disease control measures.

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