Food and Agriculture Organization of the United Nations

A risk assessment for the introduction of African swine fever into Solomon Islands

(TCP/SAP/3805)

Required citation:

FAO. 2024. *A risk assessment for the introduction of African Swine into the Solomon Islands*. Apia, FAO. https://doi.org/10.4060/cc6831en

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Acknowledgements

The authors wish to acknowledge the substantial contributions of the FAO Subregional Office for the Pacific Islands in Apia (Ms Xiangjun Yao, Ms Temwanoku Ioakim and Dr Kenneth Cokanasiga), FAO Regional Office for Asia and the Pacific in Bangkok (Dr Ian Dacre and Dr Scott Newman), the Ministry of Agriculture and Livestock of the Solomon Islands (Mr Barney Keqa, Mr Ricky Wate and Mr Francis Tsatsia) and Dr Ahmed Fayaz (EpiCentre, Massey university). Outputs would not have been achieved without their support.

Abbreviations and acronyms

ASF	African swine fever
ASFV	African swine fever virus
BSI	Biosecurity Solomon Islands
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
MAL	Ministry of Agriculture and Livestock
NDC	National Disaster Council
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
SINSO	Solomon Islands National Statistics Office
TAD	transboundary animal disease
WAHIS	World Animal Health Information System
WOAH	World Organisation for animal health

Executive summary

A risk assessment mission in the Solomon Islands was undertaken by the EpiCentre, School of Veterinary Sciences, Massey University, and the Food and Agriculture Organisation (FAO) under the FAO Technical Cooperation Programme (TCP/SAP/3805). The assessment aimed to evaluate the risk of introducing the African swine fever virus (ASFV) into the Solomon Islands. The risk assessment results are then used to recommend measures to prevent or reduce the impacts of African swine fever (ASF) incursion in the Solomon Islands.

ASF is a highly contagious viral disease that affects domestic and wild pigs. The virus was first reported in Africa and has spread to eastern Europe, China and Southeast Asia. Due to the recent ASF outbreaks in Asia and Papua New Guinea, Pacific Islands countries are now prioritizing steps to prevent the introduction of ASF. An important first step is to conduct an import risk assessment of ASFV to identify the main pathways for introduction and exposure. The knowledge informs decision making as to which measure to prevent or reduce the impact of ASF are likely to be most effective in the Solomon Islands.

The assessment of risk was conducted using the WOAH import risk analysis framework.

The assessment indicated that the likely ASFV introduction pathway for the Solomon Islands would most likely be contaminated pork products brought in by international foreign vessels for crew ration. In addition, the virus could have been introduced through arriving passengers or via the airport, as well as through the porous borders with the movement of live pigs and pork products. Should infected products enter the Solomon Islands, there is a clear pathway for exposure because pigs are routinely fed food scraps (swill) from households. The likelihood of transmission of ASFV to other susceptible pigs was considered extremely high due to the lack of farm biosecurity and the presence of feral pigs.

The assessment method was a systematic, qualitative import risk analysis of ASFV introduction to the Solomon Islands. Results provide information about high-risk areas for ASF introduction, exposure and spread in the Solomon Islands. 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 are to:

1. Closely monitoring bonded pork products from foreign vessels after leaving the checkpoints. Ensure that they comply with Biosecurity regulations.
2. Ensure construction workers undergo biosecurity checks before entering the country and declare any materials or goods they bring.
3. Increase surveillance in the border regions and critical parts of Choiseul and Western province.
4. 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.
5. Strengthen biosecurity procedures to ensure that all baggage is x-rayed and manually searched if suspect items are visible on the x-ray.
6. Ensure appropriate disposal of confiscated products through the incinerator.

7. Encourage households and restaurants to separate meat from vegetable waste and ban the supply of meat leftovers to pig owners.
8. 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.
9. Educate stakeholders on ASF clinical signs and prompt reporting by pig owners/animal workers/public of signs of disease to the Ministry of Agriculture and Livestock.
10. Promote and strengthen farm biosecurity practices, i.e., proper fencing of pigs, apply appropriate hygiene and sanitation measures.
11. 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.
12. Increase awareness of the emergency response plan for ASF with implementation and financial plan. Provide training for relevant officers.
13. 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.
14. Encourage a multi-sectoral and multidisciplinary approach (One health) to address biosecurity threats of ASF and other TADs.

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 haemorrhagic 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) such as the Solomon Islands. An outbreak of ASF in Solomon Islands 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.

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 recently expanded to cover the risk for the Solomon Islands.

1.1.2 Mission activities

Due to the travel restriction caused by the COVID-19 pandemic, EpiCentre consultants couldn't visit the Solomon Islands. Therefore, instead of face-to-face interviews administered by EpiCentre consultants, questionnaires were developed (attached in Annex) and administered by the Ministry of Agriculture and Livestock of the Solomon Islands (Mr Barney Keqa, Mr Ricky Wate and Mr Francis Tsatsia). The questionnaires were used to collect information from the following agencies in Honiara city and Western province:

- Ministry of Agriculture and Livestock (MAL),
- Biosecurity Solomon Islands (BSI),
- Customs 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. Unfortunately, the Seaport authority did not participate in the questionnaire interview.

The survey also included pig farmers to understand the farming practices and biosecurity measures in commercial/subsistence farms and local pork supply. Visits were made to two farmers and tree traders in Honiara city, four in Guadalcanal province and two in Western province. The national coordinator also conducted spot checks for imported and local pork products in the supermarket and a logging camp in the Western province.

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	1 000
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, 2020). 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 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.

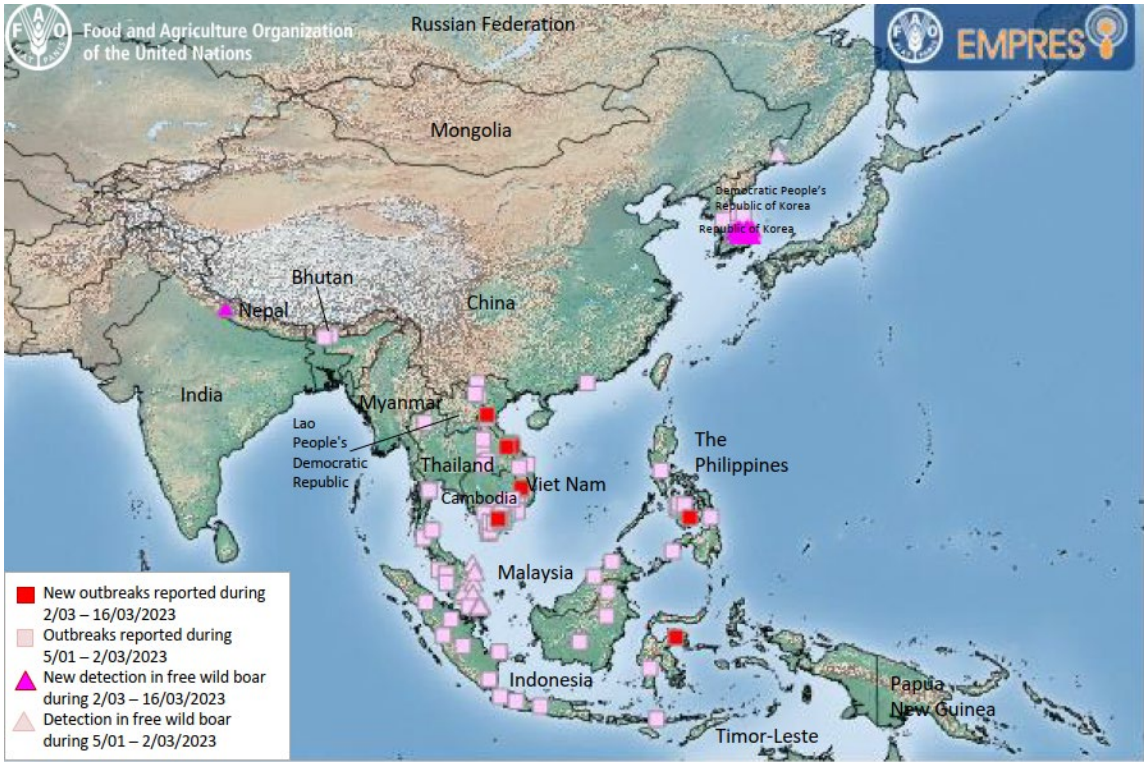

Figure 1. Current situation of ASF in Asia as of March 2023; **FAO**. (2023) ASF situation in Asia update. http://www.fao.org/ag/againfo/programmes/en/empres/ASF/situation_update.html#

3. Solomon Islands

3.1.1 General profile

The Solomon Islands, located in Melanesia, is an archipelago in the Southwest Pacific Ocean covering a land area of 28 000 km^2 (Figure 2). The country is located east of Papua New Guinea and northeast of Australia, with islands spread from northwest to southeast. The nation comprises a double chain of six large islands, including Choiseul, Santa Isabel, New Georgia, Guadalcanal, Malaita, and Makira, along with approximately 997 smaller islands and an exclusive economic zone (EEZ) covering 1 340 000 km^2 (SINSO, 2019; SINSO, 2020). Honiara, the country's capital, is located on Guadalcanal, has a land area of 21.9 km^2 and represents the country's highest population density, with 5 950 people per square kilometre (SINSO, 2020).

The provisional 2019 National Population and Housing Census reported a total population of 721 455. This represents the absolute number of people residing in approximately 124 247 private households and 1 034 institutions. Most of the population resides on the islands of Malaita (173 347) and Guadalcanal (154 150). Most people in Guadalcanal live in the country's capital, Honiara (130 176). Honiara recorded the fastest annual population growth rate of 5.8%, followed by Guadalcanal, with a rate of 3.7%. The distribution of the population by province and gender shows that there are 369 252 males (51.2%) and 352 204 females (48.8%) (SINSO, 2020).

The Solomon Islands' gross domestic product (GDP) is approximately USD 1.6 billion (UNCTAD, 2021). Solomon Islands' economy heavily depends on agriculture, forestry, and fisheries. These sectors account for around two-thirds of the country's total employment and contribute significantly to the country's GDP. The Solomon Islands is also a significant exporter of timber and logging products.

Figure 2. Location of the Solomon Islands; Source: **United Nations**. 2023. Geospatial, location data for a better world. Cited 31 March 2023. https://www.un.org/geospatial/mapsgeo/webservices

The number of households and type of agriculture holdings by province in 2017 is shown in Table 2. The total number of agricultural holdings in 2017 was 111 117, with 93 933 (85%) being individual holdings, 17 081 (15%) being family holdings, and 103 (0.1%) being joint operations. The large proportion of individual holdings was in the more populous Guadalcanal, Malaita, and the capital Honiara. The highest percentage of agriculture holdings was found in Malaita (24%), followed by Guadalcanal (22%) and Western province (16%), respectively.

The number of households keeping livestock and livestock type in various provinces of the Solomon Islands in 2017 is provided in Table 3. The number varies significantly across provinces, with Malaita and Guadacanal having the highest number of households keeping livestock (26% and 23%, respectively), while Rennell Bellona and Central have the lowest (0.7% and 2.4%, respectively). The data suggests that chickens and pigs are the most important livestock in the Solomon Islands.

Table 2. Number of households by type of agriculture holdings and province in the Solomon Islands in 2017.

Province	Type of holding			Total
	Individual	Family	Joint Operation	
Choiseul	5 888	42	-	**5 930**
Western	14 809	2 672	49	**17 530**
Isabel	6 398	356	-	**6 755**
Central	5 327	162	-	**5 489**
Rennell Bellona	74	632	2	**708**
Guadalcanal	20 225	3 772	-	**23 997**
Malaita	22 575	4 070	33	**26 678**
Makira	3 966	5 323	20	**9 309**
Temotu	4 749	52	-	**4 801**
Honiara	9 921	-	-	**9 921**
Total	**93 933**	**17 081**	**103**	**111 117**

Source: **SINSO.** 2019. Report on National Agricultural Survey 2017. Honiara, Solomon Islands: Government of Solomon Islands

Table 3. Number of households (HH) keeping livestock by type and province in the Solomon Islands in 2017.

Province	HH keeping livestock	Livestock Type				
		Cattle	Pigs	Chickens	Domestic chicken breeds	Ducks
Choiseul	3 279	15	1 639	2 476	2 476	160
Western	4 410	149	3 401	2 309	2 091	99
Isabel	3 271	-	3 011	1 429	1 408	59
Central	1 034	-	563	644	644	12
Rennell Bellona	307	-	6	307	301	-
Guadalcanal	10 131	81	8 669	3 437	3 088	149
Malaita	11 124	33	8 757	3 211	2 741	504
Makira	4 219	16	2 281	3 442	3 345	190
Temotu	3 837	15	3 627	2 405	2 405	24
Honiara	1 544	18	960	483	483	211
Total	**43 156**	**327**	**32 912**	**20 289**	**18 983**	**1 408**

Source: **SINSO.** 2019. Report on National Agricultural Survey 2017. Honiara, Solomon Islands: Government of Solomon Islands

Table 4 presents data on the number of livestock animals, categorized by type and province, in the Solomon Islands in 2017. The number of livestock animals was highest in Guadalcanal province and lowest in Rennell Bellona province. When compared by livestock type, chickens were the most abundant livestock animal across all provinces, followed by pigs. Beef and dairy cattle were present in fewer numbers than other livestock species, with their presence limited to specific provinces. The data indicate that chickens and pigs are the most widely reared livestock animals across the Solomon Islands, while the rearing of cattle and ducks is comparatively low.

Table 4. Number of livestock by type and province in the Solomon Islands in 2017.

Province	Livestock Type						Total
	Beef Cattle	Dairy Cattle	Pigs	Chickens	Domestic Chicken Breeds	Ducks	
Choiseul	15	-	5 027	28 776	28 757	1 408	**63 983**
Western	412	614	10 882	39 301	37 024	975	**89 208**
Isabel	-	-	9 528	17 729	17 640	95	**44 992**
Central	-	-	5 244	16 908	16 831	137	**39 120**
Rennell Bellona	-	-	6	5 070	4 128	-	**9 204**
Guadalcanal	830	-	42 773	66 849	26 297	1 213	**137 962**
Malaita	-	66	44 576	44 453	31 991	6 806	**127 892**
Makira	-	16	14 517	42 224	38 723	1 666	**97 146**
Temotu	-	76	12 879	23 853	23 853	169	**60 830**
Honiara	143	-	4 220	36 746	5 276	976	**47 361**
Total	**1 401**	**772**	**149 651**	**321 907**	**230 520**	**13 445**	**717 696**

Source: **SINSO.** 2019. Report on National Agricultural Survey 2017. Honiara, Solomon Islands: Government of Solomon Islands

3.1.2 PIGS

Pigs are an important livestock species in the Solomon Islands, providing food, income and serving in ceremonial activities. Although pig production is primarily traditional and non-commercial, a 2017 agriculture survey estimated that there were 149 651 pigs in 32 912 households in the country (Tables 3 & 4). Guadalcanal and Malaita have the highest number of pigs, accounting for 58%. Despite this, there are currently no biosecurity measures practised by farmers.

Most pigs in the Solomon Islands are raised on a traditional and non-commercial basis. Pigs are either penned or tethered to a tree, though some farmers allow their pigs to roam within their farm area (Figure 3). Pigs are typically fed a diet consisting of copra meal, coconut, and food waste (swill), with most households cooking the swill (Figure 4). Trading live pigs and pork between neighbouring islands are common in the country.

Boars and sows accounted for most pig holdings. Table 5 shows the number of pigs disposed of for consumption, social obligation, and sold by type and province in the Solomon Islands in 2017. Over 54 400 pigs are disposed of annually. Sixty-two percent (33 978) were sold for income, while 16 % (8 486) were disposed of for social and cultural purposes. The remaining 22% (12 024) were disposed of for consumption. The provinces with the highest number of pigs disposed of were Malaita, followed by Guadalcanal and Makira. The most common type of pig disposed of was the boar, followed by the sow (SINSO, 2019).

Figure 3. Examples of pig rearing in confined areas or tethered in the Solomon Islands; ©FAO

Figure 4. Examples of swill cooking in the Solomon Islands; ©FAO

Table 5. Number of pigs disposed of for consumption, social obligation and sold by type and province in the Solomon Islands in 2017.

Province	Pig Type															Total		
	Boar			Sow			Piglet			Weaner			Barrow					
	Consume	Social	Sold	Consume	Social	Sold	Consume	Social	Sold	Consume	Social	Sold	Consume	Social	Sold	Consume	Social	Sold
Choiseul	75	128	464	38	87	453	-	17	722	-	62	272	-	-	-	**113**	**294**	**1 191**
Western	342	302	920	259	265	847	-	-	59	-	-	-	-	-	37	**601**	**567**	**1 863**
Isabel	388	283	548	332	349	297	16	21	768	104	45	109	187	53	63	**1 027**	**751**	**1 785**
Central	16	85	528	12	31	204	25	25	80	-	13	38	-	-	-	**53**	**154**	**850**
Rennell Bellona	6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	**6**	**6**	**-**
Guadalcanal	1 074	383	2 369	871	672	2 391	-	-	828	39	25	1 846	98	54	257	**2 082**	**1 134**	**7 691**
Malaita	3 217	1 433	7 040	1 027	553	3 394	-	-	2 133	-	-	-	-	-	-	**4 244**	**1 986**	**12 567**
Makira	1 912	1 521	1 962	898	1 033	643	50	193	631	-	207	20	60	-	100	**2 920**	**2 954**	**3 356**
Temotu	371	170	1 071	207	219	709	28	76	611	-	28	107	102	86	271	**708**	**579**	**2 769**
Honiara	147	36	399	123	-	529	-	-	209	-	25	49	-	-	-	**270**	**61**	**1 186**
Total	**7 548**	**4 347**	**15 301**	**3 767**	**3 209**	**9 467**	**119**	**332**	**6 041**	**143**	**405**	**2 441**	**447**	**193**	**728**	**12 024**	**8 486**	**33 978**

Source: **SINSO.** 2019. Report on National Agricultural Survey 2017. Honiara, Solomon Islands: Government of Solomon Islands

3.1.3 PORK AND PORK PRODUCTS

Pork is a common source of protein for Solomon Islanders, and pork products such as bacon, ham, and sausages are widely consumed. Pig farmers can sell their pigs to buyers who are wholesalers and retailers of pork and other meat and animal products. These buyers purchase pigs directly from the farm and process the carcass on their property (Figure 5). Other buyers may purchase pigs for feasts and cultural occasions. Small-holder pig farmers often have direct arrangements with retailers and institutions to slaughter the pigs on-farm and cut them into the desired retail cuts or pieces. Additionally, there are direct arrangements with consumers who purchase dressed carcasses or live pigs.

To meet the local demand for meat consumption, imported meat and animal products play a significant role in the Solomon Islands (Figure 6). However, live pigs, meat, and animal products can only be legally traded from Australia, as stated in Sections 1-28 of Part 4 of the Biosecurity Act 2013 and Schedule 7 of the Biosecurity Regulations 2015. According to the combined Biosecurity airport and seaport data from 2016 to 2018, the average importation of pork was 79.1 tonnes. A summary of the pork marketing chain is shown in Figure 7.

Figure 5. An example of a pig slaughter area on a farm in the Solomon Islands; ©FAO

Figure 6. Imported pork product examples; ©FAO

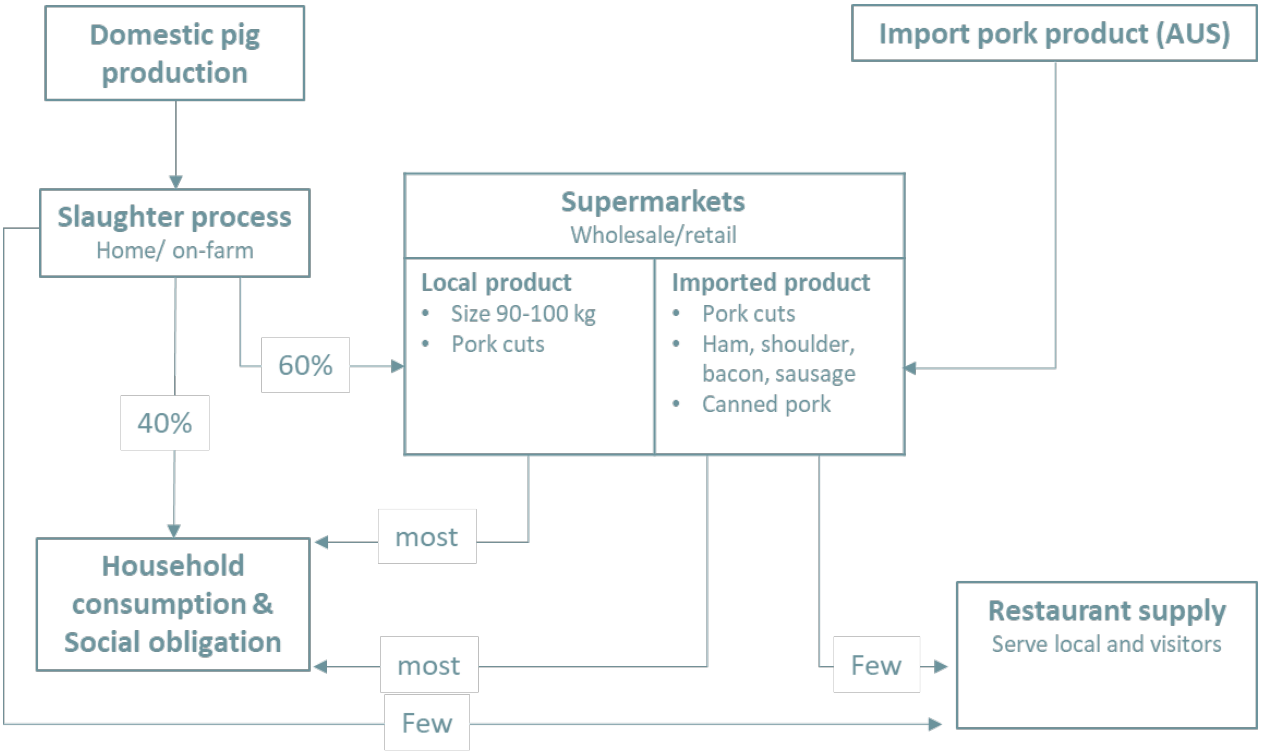

Figure 7. The value chain of pork products in the Solomon Islands; Source: elaborated by the authors.

3.1.4 Roles of agencies for preventing and responding to an ASF outbreak

The Ministry of Animal and Livestock's (MAL) Department of Livestock and Veterinary Services ensure disease-free livestock through improved and appropriate farming and production systems that promote animal health and welfare. Regarding roles and responsibilities, Livestock technical services offer advisory services, technical support, and training to rural farmers. Animal health and welfare services promote animal health, respond to farmer complaints about animal health and disease, and conduct surveillance. Livestock industry development supports commercial livestock development and value chain development. Livestock research is not yet operational, but plans are to establish a research and development unit. Lastly, livestock policy development involves developing good policies and strategies for developing all sections of livestock farming, including updating outdated policies and developing legislation for animal health and production.

One qualified veterinarian is in the country on a short-term contract. Approximately 30-40 paravets operate in the Solomon Islands. Unfortunately, there are currently unfilled positions in Choiseul and Makira provinces, and Malaita province, despite its size, only has one officer. The situation is especially concerning for Choiseul, a border province requiring animal health staff. Moreover, many experienced staff members have either retired or received a notice of retirement, resulting in a workforce comprised mainly of cadets needing guidance and mentorship. As a result, animal health and production services suffer from a significant lack of resources and capabilities, hindering effective leadership in this crucial area.

The Department of Livestock and Veterinary Services is informed through its field officers if a disease occurs. Typically, the farmer or owner of the affected livestock will contact the nearest agriculture office by phone or report in person. A team of livestock, Biosecurity, and agriculture extension personnel will conduct a rapid assessment and observe the situation closely. Outside of Honiara, the Chief Field Officer is informed through the provincial agriculture extension services office. At the provincial level, the Chief Field Officer will notify the office of the chief veterinarian and an assessment and monitoring team will be put on high alert.

Securing the border of the Solomon Islands against invasive pathogens is a task of Biosecurity Solomon Island (BSI) under MAL. The BSI 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 Solomon Islands requires a Biosecurity Import Permit and is only allowed from Australia, as stated in Sections 1-28 of Part 4 of The Biosecurity Act 2013 and Schedule 7 of the Biosecurity Regulations 2015. 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. During interviews, biosecurity officers reported manually searching all passengers' baggage and cargo declared prohibited items. Recently, x-ray machines were donated by the Australian Border Force and Japan International Cooperation Agency to enhance the country's capability to safeguard its borders against biosecurity risks. Twenty BSI officers were trained to operate the new x-ray machines (MAL, 2023).

In a biosecurity emergency like ASF, the MAL sanctions provisional measures to verify the outbreak and control its spread. The legal basis for declaring a biosecurity emergency is the Biosecurity Act 2013. Therefore, should an ASF outbreak occur, the MAL has the legal powers to coordinate the response involving several government agencies. In addition, the Biosecurity Act 2013 allows other parties, such as Police, to exercise reasonable force to ensure compliance.

During an ASF response, the Minister of MAL would declare a biosecurity emergency under the Biosecurity Act 2013 and require the Director of Biosecurity to liaise with the National Disaster Council (NDC) to undertake the most appropriate measures. The Director can require the Biosecurity officers to conduct the following activities:

- Surveillance of animal populations to ascertain the extent and status of 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 programmes, including disinfection and eradication measures.

To address the potential threat of ASF, the Department of Biosecurity has already implemented several measures, including a ban on the import of live pigs and pork, ASF awareness and training programs, an ASF emergency response plan (support from PHAMA Plus), and enhanced airport and seaport security.

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 6. The import risk analysis process is shown in Figure 8.

Table 6. Terminology for Risk Attributes and Descriptors

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

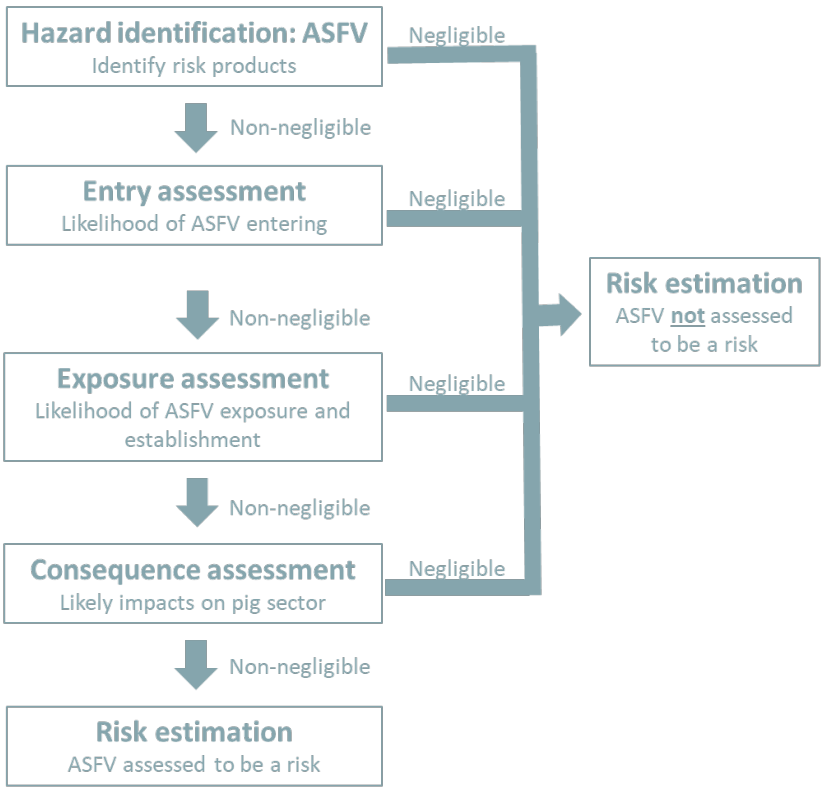

Figure 8. Import risk analysis process; Source: elaborated by the authors.

4.1.1 HAZARD IDENTIFICATION

ASFV is known to be exotic to the Solomon Islands and has been 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 Solomon Islands. According to the latest WOAH World Animal Health Information System (WAHIS), ASF was reported in Africa, the Eastern part of Europe, Russia and 18 countries in Asia, including China, Mongolia, Viet Nam, Cambodia, the 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 live pigs, pork meat products, pig feed, and contaminated fomites from these regions would pose a non-negligible risk of ASF introduction into the Solomon Islands.

4.1.2 ENTRY ASSESSMENT

The Solomon Islands is an island country located east of Papua New Guinea, which is an ASF-infected country. The Western and Choiseul provinces share a porous border with Bougainville Island of Papua New Guinea, which means that it is difficult to control the movement of live pigs and pork products across its border and poses a significant risk of ASFV introduction. A recent example was reported that agriculture extension, Biosecurity, and community leaders discovered four illegally imported weaned piglets from Bougainville. The animals were confiscated and destroyed.

Despite an allocated office space, no biosecurity officers are stationed in Choiseul, although it shares a porous border with Bougainville. Only one Biosecurity officer is stationed in the border region at Nila in the Shortland Islands. The limited staff and resources for Biosecurity, Animal Health, and Agriculture Extension in this vast region make it exceedingly challenging to ensure Biosecurity and prevent the illegal movement of livestock, animal and plant parts, and products. In addition, while it is widely believed that Bougainville on the PNG side of the border is free of ASF, no formal surveillance has been conducted in the border regions and critical parts of Choiseul and Western province. This lack of surveillance makes the border area a significant risk pathway for ASF.

In addition, ASFV entry into the Solomon Islands could be via international air and seaports. The ASFV could enter the country through contaminated pork meat products and fomites from the passenger. According to information from government agencies, live pigs have rarely been imported to the Solomon Islands. Also, a pre-departure health treatment specified on the Import Health Standard is required for all imported animals to the Solomon Islands. Legal importation of live pigs and pork products is only allowed from Australia according to the Biosecurity Act 2013 and the Biosecurity Regulations 2015. Therefore, it is less likely for ASFV to be introduced to the Solomon Islands through the legal channel.

Additionally, foreign vessels arriving from countries with African Swine Fever (ASF) infections were found to be carrying frozen pork products for their crew's ration. In 2022, fishing, logging, and cargo vessels recorded 21.3 tonnes of pork as part of their crew ration, of which 4.8 tonnes (23%) originated from ASF-infected countries such as China, Malaysia, Republic of Korea, and Thailand. that in the past, Biosecurity and Customs officers used to board incoming logging vessels to monitor the bonded items and ensure they were kept onboard and not taken ashore. However, this process is no longer being undertaken, so there are no further checks to monitor compliance after payment of the biosecurity bond. As a result, it is unclear whether the crews of these vessels truly respect and adhere to the bonds. This lack of monitoring and data poses a risk to Biosecurity and highlights the need for increased surveillance and enforcement measures.

In addition, ASFV could be introduced into the Solomon Islands via passengers illegally bringing infected pork products upon international arrival. All passengers must fill in arrival cards and declare whether they carry food items. A false declaration incurred a fine of 1 000 000 Solomon dollars and a risk of up to five years in jail (BSI, 2023). While manually searching all arriving passengers' luggage was 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 biosecurity officer narrated that they confiscated

pork products (e.g., pork cuts, crispy pork, frozen ham, bacon, and sausage) from passengers a couple of times per month (before the COVID-19 restriction). In addition, an influx of construction workers from Asia was recorded in the past two years.

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 Solomon Islands, could bring contaminated fomites into the country. According to the Biosecurity offices, before the COVID-19 pandemic, approximately 55 000 passengers arrived in the Solomon Islands annually. Most passengers were returning residents or travellers from Australia, followed by the USA, Papua New Guinea and New Zealand. The main flights were from Brisbane, Port Moresby, Nadi and Nauru. According to a record in 2017, it was estimated that 16% of passengers are from Asia, where ASF is currently endemic in some parts. 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 Solomon Islands.

International waste originating from aeroplanes and ships arriving from endemic countries is another important pathway of ASF introduction (Costard *et al.*, 2009). Different maritime transport vessels arrive in the Solomon Islands, such as commercial ships with cargo, logging vessels, fishing vessels and yachts. It was narrated that the disposal of catering waste to the Solomon Islands for any foreign aircraft and vessel is through the incinerator located at Honiara and Noro ports.

Together, these factors pose a significant threat to the introduction of ASFV into the Solomon Islands. The likelihood of ASFV entry through foreign vessels and arrival passengers is non-negligible. Figure 9 summarises the pathway by which ASFV might enter the Solomon Islands.

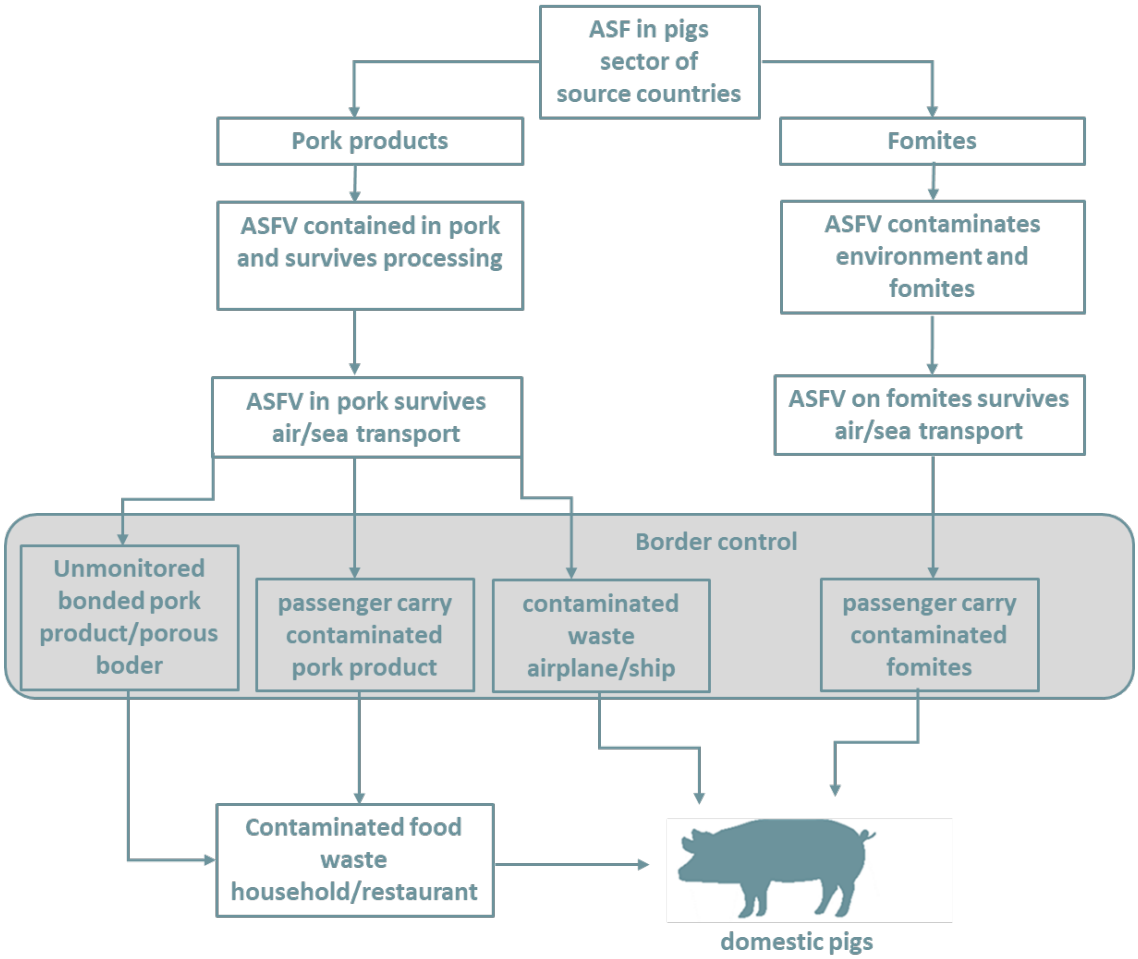

Figure 9. The risk pathway of African Swine Fever virus into the Solomon Islands; Source: elaborated by the authors.

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, it was narrated that swill feeding is common in the Solomon Islands. As a result, household scraps or food wastes could be contaminated with infected pork meat. Although most pig farmers reported cooking waste materials before feeding them to pigs, it is difficult to ensure that traditional cooking over an open fire is sufficient to inactivate the virus. Thermal inactivation at a core temperature of 70°C for a minimum of 30 minutes is required to destroy ASFV (Beltran-Alcrudo *et al.*, 2017).

Feral pigs may play a key role in ASFV exposure and spread. Feral pigs could be exposed to food waste by scavenging food waste with contaminated pork meat products or fomites contaminated by villagers. In addition, there might be some 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. Despite the potential for interaction between domestic and feral pigs, such interactions are uncommon as feral pigs are typically found in rainforests. This is supported by the fact that all surveyed farms indicated that they had never seen wild pigs near the homestead. Nevertheless, the likelihood of ASFV exposure is non-negligible.

4.1.4 CONSEQUENCE ASSESSMENT

The spread of ASFV in the pig population depends on the speed of transmission and its economic impact. Once established, ASFV spreads rapidly among pig populations. Pig farms in the Solomon Islands generally have no or very low levels of biosecurity, a lack of which is recognized as a risk factor for ASF transmission (Sanchez-Vizcaino *et al.*, 2015). Given the trade of pigs is common practice in the Solomon Islands, 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.

Inadequate home slaughter facilities, sewage, and waste disposal could be potential infection sources. The guts and trim wastes were normally burnt, fed to dogs, or thrown at sea. They could be accessible by feral pigs. Due to ASF being absent from the Solomon Islands, farmers are unaware of the disease and its transmission mechanisms. A lack of awareness could increase the time from introduction to detection, which would increase the size of the epidemic. A disease outbreak is unlikely to be promptly reported to MAL if farmers are unaware of it. Moreover, vehicles for transporting pigs, pig feed, and equipment may be shared.

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 case of an ASF outbreak in the Solomon Islands, it is speculated that a timely response to prevent the spread of ASF may not occur. A survey from MAL narrated that there is currently no active/passive surveillance system for animal diseases. Also, it was reported that there is limited capacity to manage/control/contain an animal disease outbreak in the Solomon Islands.

The domestic pig population of the Solomon Islands consists of approximately 150 000 animals reared on 33 000 properties, mostly backyard piggeries (SINSO 2019). Pigs are an integral component of the agriculture of the Solomon Islands. They have cultural values and provide food security, high-protein nutrition, and financial assets. Therefore, the socio-economic consequences of introducing and establishing ASF for the Solomon Islands 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 Solomon Islands.

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 both 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 Solomon Islands.

5. Recommendations

5.1.1 Reducing the likelihood of ASF entry

The main pathways for entry of ASFV into the Solomon Islands are pork products. The less likely but non-negligible pathway was through contaminated fomites (boots, gears). These could enter via porous borders, cargo, package and passenger's luggage. To reduce the likelihood of entry, we recommend the following:

- Closely monitoring bonded pork products from foreign vessels. Ensure that they comply with Biosecurity regulations.
- Ensure construction workers undergo biosecurity checks before entering the country and declare any materials or goods they bring.
- Increase surveillance in the border regions and critical parts of Choiseul and Western province.
- 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). In addition, 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.
- 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 Solomon Islands.
- 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, public services, Customs, Airport Authority and Ports Authority).
- Strengthen biosecurity procedures and infrastructure to ensure that all baggage is x-rayed and manually searched if suspect items are visible on the x-ray.
- Address the lack of resources and capabilities in Biosecurity and animal health by increasing staff and providing training.

5.1.2 Reducing the likelihood of ASF exposure

From risk analysis, pigs raised in Solomon Island would primarily be exposed to ASFV via waste feeding of meat scraps with ASFV present. The consultants recommend a public awareness campaign focused on the negative impacts of ASF and highlighting the need to 1) avoid feeding meat waste to pigs and 2) cook waste for food waste should be thoroughly cooked to reach the core temperature of 70°C for 30 minutes. Since few farmers will have thermometers, we recommend a simple message of boiling for one hour. While it would be preferable to avoid swill feeding altogether, that is not realistic, given the cost and availability of commercial feed. Public awareness, including social media, TV, radio, printed materials, posters and organize meetings for those who raise pigs as well as the public, should focus on encouraging the separation of meat from vegetable waste. Consideration should be given to implementing a ban on the feeding of meat.

5.1.3 REDUCING THE SIZE OF AN OUTBREAK

Early detection is the key to preventing the further spread of an ASF outbreak. Effective prevention requires a monitoring and surveillance system, facilitating early detection and timely intervention. Sufficient budget and personnel resources must be allocated to motivate early reporting, implement active disease investigation and control, and organize access to laboratories capable of diagnosing ASF. MAL should provide information for veterinary paraprofessionals and livestock owners to recognize ASF and report promptly. Those who care for pigs need to be aware of the signs of ASF and be given clear information as to who they need to notify is suspicious. Ways to raise awareness include social media, TV, radio, printed materials, posters, and organize meetings with those responsible for caring for pigs.

Once infected with ASF, all animals on the infected property, whether affected or unaffected, must be destroyed and disposed of correctly to prevent further spread. The Solomon Islands government need to train and equip sufficient personnel for rapid culling and carcass disposal and cleaning and disinfection in the event of an outbreak. Such an action plan to mitigate the impact of ASF infection would require compliance from pig owners. Therefore, there needs to be a compensation strategy and allocate financial resources to ensure adequate compensation for removing and disposing of affected pig herds as part of disease control measures.

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Annex 1. Questionnaires and data items

Following data items are submitted in electronic format

1. ASF Import Risk Assessment Questionnaires
2. GEMP questionnaire completed by MAL
3. ESRI shapefile of the Solomon Islands administrative division (GADM)
4. ESRI shapefile of the Solomon Islands OpenStreetMap (OSM)
5. of the Cook Islands OpenStreetMap (OSM)

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CC6831EN/1/01.24

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