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Knowledge, attitude and practices of pig farmers post African swine fever outbreaks in Ogun and Oyo states of Nigeria

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Abstract

The experience during African swine fever (ASF) virus outbreak can be devastating. This study aimed to assess the knowledge, attitude and practise among pig farmers to avoiding resurgence of ASF outbreaks in Oyo and Ogun States of Nigeria where ASF outbreaks had been earlier reported. Non participatory observations and participatory interviews using pre-tested structured questionnaire were conducted in 2016 among 92 consenting pig farms post-ASF outbreak. The study showed that one in two of pig farms studied had suffered from ASF outbreak before. Meanwhile, several bio-security breaches that facilitate ASF and other infectious agents spread were still maintained including 'farm restocking with ASF survivor pigs' (61.5%; 32/52), 'boar lending among farms for breeding purposes without examination' (54.3%; 50/92), 'extensive system and semi-intensive pig management' (21.7%; 20/92), 'farm attendants sharing among pig farms' (19.6%; 18/92), 'farm equipment/ implements/ facilities sharing among farms' (22.8%; 21/92), selling of pig carcass (9.8%; 9/92), 'carcass disposal in the bush' (19.6%; 18/92). In this study we found out that management and bio-security activities in the pig farms studied were still poor and could place them at high risk of infection and repeated disease outbreaks in the future. The study suggests that pig farmers had not learnt from the previous ASF outbreaks. Therefore, proper sensitization on ASF epidemiology, public health significance and socioeconomic impact should be carried out. This study calls for swift action to prevent future calamities in pig production facilities in the study areas.

Keywords: African swine fever, Biosecurity, Nigeria, Outbreak, Sensitization

Introduction

Several disease outbreaks have been reported among livestock industry in Nigeria, African swine fever (ASF) remains one of the major limiting diseases in pig production (Saka *et al*., 2010; Fasina *et al*., 2011).

The disease is caused by African swine fever virus (ASFV) which is the only member of the family *Asfarviridae*. It possesses a double stranded deoxyribonucleic acid genome with a complex molecular structure. ASFV is the only tick-borne DNA virus transmitted commonly by *Ornithodoros* species (soft tick) (Kleiboeker *et al.,* 1999; FAO, 2000; Dixon *et al.,* 2005).

ASF impacts negatively on rural and urban economies, tradition and culture, and also limit international trade (FAO, 1998). It is a highly contagious viral disease of swine population resulting into 100% mortality in domestic pigs, yet without precipitating clinical disease in wild (natural) suid such as warthogs and bush pigs (Spickler, 2015). Generally, clinical signs and mortality rates have been reported to vary depending on virus virulence and breed of pig infected. Clinical manifestations could be peracute form (sudden death), acute form (pyrexia, depression, anorexia, skin haemorrhages, abortion, cyanosis, vomiting, diarrhoea and death within 6-13 day with ≤ 100% mortality rates), subacute and chronic form (loss of weight, intermittent fever, respiratory signs, chronic skin ulcers and arthritis) (Spickler, 2015). Differential diagnoses of ASF include classical swine fever, erysipeloid, trypanosomosis, porcine reproductive and respiratory syndromes, coumarin poisoning, salt poisoning, purpura haemorrhagica, post-weaning multisystemic wasting syndrome, porcine dermatitis and nephropathy syndrome, salmonella or pasteurella-contagion and any intestine or respiratory disease with fever against which antibiotics have no effect (FAO, 2000). However, laboratory diagnosis like the use of haeadsorption test, indirect fluorescent antibody (IFA) tests, immunoblotting, immunoperoxidase test, enzyme linked immunosorbent assay and polymerase chain reaction, have been described (FAO, 2000; Spickler, 2015).

ASF is classified among transboundary animal diseases which can be spread with ease by live pig or their carcass, wild or domestic pigs, pig products (pork, meat and skin) and by-products (pig skin, bristles and manure), contaminated feed and formites (clothes, shoes, vehicles, equipment) (Spickler, 2015). The complexity in the epidemiology of ASFV is attributed to the environmental condition, pig management system, tick availability (especially *Ornithodorus*, soft tick), human behaviour and availability of wild suids (Costard *et al.,* 2009; Fasina *et al.,* 2010; FAO, 2010). The genetic diversity among ASFV strains and subsequent immune response evasion has made vaccine development challenging (Bastos *et al.,* 2003; Boshoff *et al.,* 2007; Dixon *et al.,* 2008; Costard *et al.,* 2009; Achenbach *et al.,* 2017). This lack of effective vaccine against ASFV is a pitfalls likely making the spread easy. The only options left to prevention of ASF in pig production facilities include standard quarantine system, stringent bio-security measures and prompt laboratory diagnosis in case of suspected case (as clinical signs are closely similar to classical swine fever which has effective vaccine) (Penrith & Vosloo, 2009).

The study was set up to evaluate the activities of pig producers in two states of Nigeria where ASF outbreaks have been reported (Babalobi *et al*., 2007; Fasina *et al*., 2010). It aimed to know the likely pitfalls for ease of spread of ASF and other contagious infectious agents in swine production facilities in Nigeria.

Materials and Methods

Study location

The study was carried out on pig farms located in two states of Nigeria after major African swine fever outbreaks between 2006 and 2012. In Oyo state, Ibarapa East (longitude 7°36'28.62" N and latitude 3°29'31.45" E) and Ibarapa central (longitude 7°26'14.53" N and latitude 3°16'3.40" E) Local Government Areas were randomly selected while Ewekoro (longitude 6°56′00″N and latitude 3°13′00″E) and Ifo (longitude 6°49′00″N and latitude 3°12′00″E) Local Government Areas were selected in Ogun State.

Data collection

Distant and close observations of the farms were done to assess personal hygiene, environmental hygiene, carcass disposal point, accessibility of rodents to pig pens and stores where feeds are kept, and the methods of pig husbandry.

Interview

A pre-tested structured questionnaire was administered by interview to obtain information on demography, carcass disposal methods, personal hygiene, availability of holding and isolation facilities, environmental hygiene, health programme, feed and feeding patterns, best practices and sources of stocking and restocking. The interview was conducted using focus group discussion method with a minimum of 3 active farm workers per group (farm).

Data analysis

The data was entered into Statistical Package for Social Sciences (SPSS) version 15.0. for descriptive analyses (frequency and percentage). Inferential

statistics was also done using Chi-Square test and value $p<0.05$ was said to be significant.

Results

A total of 41 farms were interviewed including 16 and 25 pig farms in Ibarapa central and Ibarapa east Local Government Areas respectively. In Ogun State, 51 pig farms were interviewed including 18 and 33 farms in Ewekoro and Ifo Local Government Areas respectively.

Among people involved in pig production, 37% (34/92) of them were above 54 years of age (Table 1) and this represents the highest age range. The study showed that pigs were mainly kept by male (70.7%; 65/92). Also, more than 50% of pig farmers had tertiary education. Although, 39.1% (36/92) pig farmers stated that livestock production is their primary occupation, 60.9% (56/92) took pig farming as secondary occupation. The percentage distribution of the number of pigs in the farms interviewed were almost the same, though keeping of 15 – 20 pigs/farm was the highest range (34.8%). In this study, most of the pig farms within which ASF outbreak had occurred before were established 10 – 20 years ago (45.7%), <10 years (39.1%) and >20 years (15.2%).

So far in the establishment of the pig farm in study area, a total of 52 farms (56.5%) had experienced ASF outbreak (Table 2) after which it took 3-6 months

Table 1: Demographic data of swine farmers in Oyo and Ogun States, Nigeria

Features	Ewekoro n= 18 (%)	Ifo n= 33 (%)	Ibarapa East n= 25 (%)	Ibarapa Central n= 16 (%)	Total n= 92 (%)
Age (years)					
<40	9 (50.0)	8 (24.2)	8 (32.0)	7 (43.8)	32 (34.8)
40 – 54	3 (16.7)	10 (30.3)	9 (36.0)	4 (25.0)	26 (28.2)
>54	6 (33.3)	15 (45.5)	8 (32.0)	5 (31.3)	34 (37.0)
*Sex					
Male	11 (61.1)	20 (60.6)	22 (88.0)	12 (75.0)	65 (70.7)
Female	7 (38.9)	13 (39.4)	3 (12.0)	4 (25.0)	27 (29.3)
Highest educational level					
None	3 (16.78)	0 (0.0)	2 (8.0)	3 (18.8)	8 (8.7)
Functional literacy	0 (0.0)	0 (0.0)	1 (4.0)	0 (0.0)	1 (1.1)
Primary	5 (27.8)	0 (0.0)	4 (16.0)	2 (12.5)	11 (12.0)
Secondary	2 (11.1)	5 (15.2)	7 (28.0)	5 (31.3)	19 (20.7)
Tertiary education	8 (44.4)	28 (84.8)	11 (44.0)	6 (37.5)	53 (57.6)
Primary occupation					
Civil servant	3 (16.7)	3 (9.1)	9 (36.0)	2 (12.5)	17 (18.5)
Crop farming	8 (44.4)	19 (57.6)	0 (0.0)	4 (25.0)	31 (33.7)
Livestock farmer	4 (22.2)	11 (33.3)	13 (52.0)	8 (50.0)	36 (39.1)
Artisan	3 (16.7)	0 (0.0)	2 (8.0)	2 (12.5)	7 (7.6)
Others	0 (0.0)	0 (0.0)	1 (4.0)	0 (0.0)	1 (1.1)
How many pigs are on the farm?					
<15	4 (22.2)	15 (45.5)	7 (28.0)	3 (18.8)	29 (31.5)
15-20	7 (38.9)	7 (21.1)	11 (44.0)	7 (43.8)	32 (34.8)
>20	7 (38.9)	11 (33.3)	7 (28.0)	6 (37.5)	31 (33.7)
How long has the farm been established (in years)?					
<10	8 (44.4)	12 (36.4)	11 (44.0)	5 (31.3)	36 (39.1)
10 – 20	8 (44.4)	14 (42.4)	11 (44.0)	9 (56.3)	42 (45.7)
>20	2 (11.1)	7 (21.2)	3 (12.0)	2 (12.5)	14 (15.2)

*Significant difference was found based on sex of pig farmers in the two states (p= 0.0204)

Table 2: Pig farmers experience during ASFV outbreak of 2006-2015 in Oyo and Ogun States, Nigeria

Features	Ewekoro n= 18 (%)	Ifo n= 33(%)	Ibarapa East n= 25 (%)	Ibarapa Central n= 16 (%)	Total n= 92 (%)
Have you ever experienced African swine fever outbreak on your farm?					
Yes	14 (77.8)	19 (57.6)	6 (24.0)	13 (81.3)	52 (56.5)
No	4 (22.2)	14 (42.4)	19 (76.0)	3 (18.8)	40 (43.5)
j How long did it take you to restock after outbreak?					
< 3 months	4 (28.6)	9 (47.4)	0 (0.0)	4 (30.8)	17 (32.7)
3 – 6 months	7 (50.0)	6 (31.6)	0 (0.0)	7 (53.8)	20 (38.5)
> 6 months	3 (21.4)	4 (21.1)	6 (1-00.0)	2 (15.4)	15 (28.8)
j Did you at any time use survivors for restocking on your farm?					
Yes	11 (78.6)	11 (57.9)	0 (0.0)	10 (76.9)	32 (61.5)
No	3 (21.4)	8 (42.1)	6 (100.0)	3 (23.1)	20 (38.5)
Sudden death					
Yes	7 (38.8)	18 (54.5)	14 (56.0)	7 (43.8)	46 (50.0
No	11 (61.1)	15 (45.5)	11 (44.0)	9 (56.3)	46 (50.0)
Loss of appetite					
Yes	13 (72.2)	23 (70.0)	19 (76.0)	11 (68.8)	66 (71.7)
No	5 (27.8)	10 (30.3)	6 (24.0)	5 (31.2)	26 (28.3)
Presence of red loose skin colouration in the ventral abdomen, tips of ears or tail or distal limb					
Yes	13 (72.2)	20 (60.6)	6 (24.0)	12 (75.0)	51 (55.4)
No	5 (27.8)	13 (39.4)	19 (76.0)	4 (25.0)	41 (44.6)
Difficulty in breathing					
Yes	11 (61.1)	23 (70.0)	9 (36.0)	8 (50.0)	51 (55.4)
No	7 (38.9)	10 (30.3)	16 (64.0)	8 (50.0)	41 (44.6)
Abortion					
Yes	6 (33.3)	21 (63.6)	10 (40.0)	3 (18.8)	40 (43.5)
No	12 (66.7)	12 (36.4)	15 (60.0)	13 (81.2)	52 (56.5)
Increase in water intake and wallowing					
Yes	10 (55.6)	24 (72.7)	6 (24.0)	10 (62.5)	50 (54.3)
No	8 (44.4)	9 (27.3)	19 (76.0)	6 (37.5)	42 (45.7)
Reddening of the ears					
Yes	13 (72.2)	18 (54.5)	6 (24.0)	12 (75.0)	49 (53.3)
No	5 (27.8)	15 (45.5)	19 (76.0)	4 (25.0)	43 (46.7)

Key: [j] Number of responses was based on previous response

(38.5%), < 3 months (32.7%) and >6 months (28.8%) to recover from their losses. However, 61.5% (32/52) used their ASF survivors as part of post-outbreak stock. Generally, during the ASF outbreak, some of the observable clinical signs among pigs include sudden death (50%, n=46/92), presence of red loose skin coloration (in the ventral abdomen, tips of ears or tail or distal limbs) (55.4%, 51/92), reddening of the ears (53.3%, 49/92), abortion (43.5%, 40/92), anorexia (71.7%, 66/92), dyspnoea (55.4%, 51/92) and increase in water intake and wallowing (54.3%, 50/92).

Also, 40.2% (37/92) pig farms did not have carcass disposing point (CDP) (Table 3) and those that have had their CDP as close as <10 meters (67.3%, 37/55) to the regular point (production pen). General handling/processing of pig carcasses include 'burying' (41.3%, 38/92), 'throwing into surrounding bush' (19.6%), 'burning' (18.5%), 'sell' (9.8%) and 'use chemical' (5.4%).

Based on bio-security measurement, only 53.3% (49/92) farms had quarantine facility which was just 8-10meter away from the regular pen (51%, 25/49) (Table 4a). The quarantine facility was reported to hold pigs for 3 weeks (98%, 48/49). Provision for sick pigs (isolation pen) was only made in 59.8% (55/92) of the pig farms with distance of 8 -10 meters to the regular pen (65.5%, 36/92). New pig stocks for the farm were not usually subjected to laboratory test (46.7%, 43/92). Most of the farmers do wash their hands (97.8%) and farm implements (92.4%) after touching or carrying dead pigs while 17.4% farmer do not wash their clothes after this process.

Only 60.9% (56/92) had rodent control programme in their farm (Table 4b). Problem of tick infestation was claimed by 31.5% (29/92) of the pig farmers. Both tick bath and chemical spray were carried out by 65.5% of the farmers. The use of various access deterrents differs from these pig farms as 57.6% of the farms had bio-security information sign at the farm entrance while 60.9% had perimeter fencing or gated driveway. Other environmental hygiene practices include presence of pest control program (44.65), excessive debris and vegetation inside perimeter (26.1%), birds have access to pigs or feed in pig house (51.1%), dogs/cats have access to pigs or feed in pig house (16.3%), rodents and reptiles have access to pigs and feed in pig house (41.3%) and feed spills are cleansed up immediately (37%).

Based on management of pig and the human workers in the farm, the following were observed by the farmers (Table 5): replacement stock produced and grown within your farm (82.6%), non-available of pigs for vaccination against classical swine fever and erysipelas vaccinations (16.3%), non-intensive pig management system (21.7%), no prophylactic measures against arthropods (tick, fleas and mites) (27.2%), feed mill does not follow adequate bio-security and quality control procedure (55.4%), use non-decontaminated feeds of animal origin (especially slaughterhouse wastes) in pig's diet (43.5%), feed delivered to the farm on the same load as other farm deliveries (44.6%), feed truck usually dirty on arrival (either inside cab or externally) and enters the farm (47.8%), driver doesn't wear coveralls and clean boots each delivery (43.5%) and driver enter farm and pens during delivery (19.6%).

Approximately 20% of the pig farms share farm

Table 3: Carcass disposal during and after ASFV outbreak (2006-2015) in Oyo and Ogun State, Nigeria

Features	Ewekoro n= 18 (%)	Ifo n= 33 (%)	Ibarapa East n= 25 (%)	Ibarapa Central n= 16 (%)	Total n= 92 (%)
Do you have a carcass disposal point (CDP)?					
Yes	13 (72.2)	25 (75.8)	5 (20.0)	12 (75.0)	55 (59.8)
No	5 (27.8)	8 (24.2)	20 (80.0)	4 (25.0)	37 (40.2)
[j] What is the approximate distance of the CDP to regular point?					
<10 meters	8 (61.5)	21 (84.0)	0 (0.0)	8 (66.7)	37 (67.3)
10 – 20 meters	5 (38.5)	4 (16.0)	0 (0.0)	4 (33.3)	13 (23.6)
20 – 30 meters	0 (0.0)	0 (0.0)	2 (40.0)	0 (0.0)	2 (3.6)
>30 meter	0 (0.0)	0 (0.0)	3 (60.0)	0 (0.0)	3 (5.5)
How do you dispose carcasses?					
Burning	5 (27.8)	7(21.2)	0 (0.0)	5 (31.3)	17 (18.5)
Burying	6 (33.3)	16 (48.5)	10 (40.0)	6 (37.5)	38 (41.3)
Use of chemical	3 (16.7)	1 (3.0)	0 (0.0)	1 (6.3)	5 (5.4)
Throw it into the bush	2 (11.1)	5 (15.2)	9 (36.0)	2 (12.5)	18 (19.6)
Sell it off	1 (5.6)	2 (6.1)	5 (20.0)	1 (6.3)	9 (9.8)
Others	1 (5.6)	2 (6.1)	1 (4.0)	1 (6.3)	5 (5.4)

Key: [j] Number of responses is based on previous response

Table 4a: Biosecurity measurement in pig farms post-ASFV outbreak (2006-2015) in Oyo and Ogun States, Nigeria

Features	Ewekoro n= 18(%)	Ifo n= 33(%)	Ibarapa East n= 25 (%)	Ibarapa Central n= 16 (%)	Total n= 92 (%)
Do you have a quarantine facility?					
Yes	12 (66.7)	22 (66.7)	4 (16.0)	11 (68.8)	49 (53.3)
No	6 (33.3)	11 (33.3)	21 (84.0)	5 (31.2))	43 (46.7)
[j] For how long do you quarantine your pigs?					
3 weeks	11 (91.7)	22 (100.0)	4 (100.0)	11 (100.0)	48 (98.0)
> 3 weeks	1 (8.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.0)
[j] Distance between quarantine facility and regular pen					
5-7 meters	0 (0.0)	18 (81.8)	0 (0.0)	0 (0.0)	18 (36.7)
8 – 10 meters	8 (66.7)	4 (18.2)	3 (75.0)	10 (90.9)	25 (51.0)
>10 meters	4 (22.2)	0 (0.0)	1 (25.0)	1 (9.1)	6 (12.2)
Do you have an isolation pen which is different from other pens?					
Yes	14 (77.8)	22 (66.7)	7 (28.0)	12 (75.0)	55 (59.8)
No	4 (22.2)	11 (33.3)	18 (72.0)	4 (25.0)	37 (40.2)
[k] Approximate distance between isolation pen and regular pen					
5-7 meters	0 (0.0)	15 (68.2)	0 (0.0)	0 (0.0)	15 (27.3)
8 – 10 meters	12 (85.7)	7 (31.8)	5 (71.4)	12 (100.0)	36 (65.5)
>10 meters	2 (14.3)	0 (0.0)	2 (28.6)	0 (0.0)	4 (7.3)
Do you carry any laboratory test on pigs?					
Yes	18 (100.0)	18 (54.5)	1 (4.0)	12 (75.0)	49 (53.3)
No	0 (0.0)	15 (45.5)	24 (96.0)	4 (25.0)	43 (46.7)
Do you wash hands after touching or carrying dead pigs?					
Yes	16 (88.9)	33 (100.0)	25 (100.0)	16 (100.0)	90 (97.8)
No	2 (11.1)	0 (0.0)	0 (0.0)	0 (0.0)	2 (2.2)
Do you wash your clothes after touching or carrying dead pigs?					
Yes	15 (83.3)	25 (75.8)	22 (88.0)	14 (87.5)	76 (82.6)
No	3 (16.7)	8 (24.2)	3 (12.0)	2 (12.5)	16 (17.4)
Do you wash your farm implements after carrying dead pigs?					
Yes	13 (72.2)	32 (97.0)	25 (100.0)	15 (93.8)	85 (92.4)
No	5 (27.8)	1 (3.0)	0 (0.0)	1 (6.2)	7 (7.6)

Key: [j] Number of responses was based on farms that have isolation pen different from other pens

workers with other pig farms, while 22.8% (21/92) pig farms share implements, utilities and facilities together. The lending of boars among farms for reproduction was practised in 54.3% (50/92) of the pig farms.

Discussion

Although the first ASF outbreak in Nigeria was reported to have occurred in 1973, however since 1997, the pig industry in Nigeria has been socioeconomically ravaged by sporadic multifoci outbreaks of ASF (FAO, 1998; FAO, 2000). Our study

Table 4b: Biosecurity measurement in pig farms post ASFV outbreak (2006-2015) in Oyo and Ogun States, Nigeria

Features	Ewekoro n= 18 (%)	Ifo n= 33(%)	Ibarapa East n= 25 (%)	Ibarapa Central n= 16 (%)	Total n= 92 (%)
Do you have a program for controlling rodents on the farm?					
Yes	11 (61.1)	18 (54.5)	18 (72.0)	9 (56.2)	56 (60.9)
No	7 (38.9)	15 (45.5)	7 (28.0)	7 (43.8)	36 (39.1)
Do you have a problem of tick infestation on the farm?					
Yes	3 (16.7)	7 (21.2)	17 (68.0)	2 (12.5)	29 (31.5)
No	15 (83.3)	26 (78.8)	8 (32.0)	14 (87.5)	63 (68.5)
[j] How do you control tick?					
Tick bath	0 (0.0)	0 (0.0)	6 (35.3)	0 (0.0)	6 (20.7)
Chemical spray	0 (0.0)	4 (57.1)	0 (0.0)	0 (0.0)	4 (13.8)
Both	3 (100.0)	3 (42.9)	11 (64.7)	2 (100.0)	19 (65.5)
Presence of bio-security information signs at entrance					
Yes	16 (88.9)	15 (45.5)	9 (36.0)	13 (81.2)	53 (57.6)
No	2 (11.1)	18 (54.5)	16 (64.0)	3 (18.8)	39 (42.4)
Presence of perimeter fencing or gated driveway					
Yes	5 (27.8)	18 (54.5)	22 (88.0)	11 (68.8)	56 (60.9)
No	13 (72.2)	15 (45.5)	3 (12.0)	5 (31.2)	36 (39.1)
Presence of pest control program					
Yes	13 (72.2)	14 (42.4)	10 (40.0)	4 (25.0)	41 (44.6)
No	5 (27.8)	19 (57.6)	15 (60.0)	12 (75.0)	51 (55.4)
Excessive debris and vegetation inside perimeter					
Yes	4 (22.2)	9 (27.3)	8 (32.0)	3 (18.8)	24 (26.1)
No	14 (77.8)	24 (72.7)	17 (68.0)	13 (81.2)	68 (73.9)
Birds have access to pigs or feed in pig house					
Yes	12 (66.7)	16 (48.5)	10 (40.0)	9 (56.2)	47 (51.1)
No	6 (33.3)	17 (51.5)	15 (60.0)	7 (43.8)	45 (48.9)
Dogs/cats have access to pigs or feed in pig house					
Yes	5 (27.8)	2 (6.1)	2 (8.0)	6 (37.5)	15 (16.3)
No	13 (72.2)	31 (93.9)	23 (92.0)	10 (62.5)	77 (83.7)
Rodents and reptiles have access to pig and feed in pig house					
Yes	8 (44.4)	22 (66.7)	3 (12.0)	5 (31.2)	38 (41.3)
No	10 (55.6)	11 (33.3)	22 (88.0)	11 (68.8)	54 (58.7)
Feed spills are cleansed up immediately					
Yes	6 (33.3)	5 (15.2)	20 (80.0)	3 (18.8)	34 (37.0)
No	12 (66.7)	28 (84.8)	5 (20.0)	13 (81.2)	58 (63.0)

Key: [j] Number of responses was based on farms that had problem of tick infestation

showed that 52 pig farms (56.5%) had experienced ASF since their establishment. Our study showed that 52 pig farms (56.5%) had experienced ASF since their establishment. This indicated that one in two of pig farms in the study areas had suffered from ASF outbreak, thus impeding and delaying expected farm growth and development as recovery from outbreaks took > 6 months (15/52 pig farms) (Table 2). In fact, this outbreak had made some pig farmers to quit business because of unrecoverable financial loss.

Table 5: Pigs and workers management after ASFV outbreak (2006-2015) in Oyo and Ogun States, Nigeria

Features	Ewekoro n= 18 (%)	Ifo n= 33 (%)	Ibarapa East n= 25 (%)	Ibarapa Central n= 16 (%)	Total n= 92 (%)
Are all replacement stock produced and grown within your farm?					
Yes	14 (77.8)	29 (87.9)	17 (68.0)	16 (100.0)	76 (82.6)
No	4 (22.2)	4 (12.1)	8 (32.0)	0 (0.0)	16 (17.4)
Do you make your pigs available for vaccination carried out by the veterinary service (against classical swine fever, erysipelas)?					
Yes	16 (88.9)	32 (97.0)	13 (52.0)	16 (100.0)	77 (83.7)
No	2 (11.1)	1 (3.0)	12 (48.0)	0 (0.0)	15 (16.3)
Do you keep your pigs indoors (intensive system) only?					
Yes	15 (83.3)	31 (93.9)	12 (48.0)	14 (87.5)	72 (78.3)
No	3 (16.7)	2 (6.1)	13 (52.0)	2 (12.5)	20 (21.7)
Do you carry out prophylactic measures against mites, lice, fleas?					
Yes	12 (66.7)	29 (87.9)	13 (52.0)	13 (81.2)	67 (72.8)
No	6 (33.3)	4 (12.1)	12 (48.0)	3 (18.8)	25 (27.2)
Does feed mill follow adequate bio security and quality control procedure?					
Yes	5 (27.8)	26 (78.8)	5 (20.0)	5 (31.2)	41 (44.6)
No	13 (72.2)	7 (21.2)	20 (80.0)	11 (68.8)	51 (55.4)
Do you use non-decontaminated feeds of animal origin (especially slaughterhouse wastes) in pig's diet?					
Yes	8 (44.4)	16 (48.5)	9 (36.0)	7 (43.8)	40 (43.5)
No	10 (55.6)	17 (51.5)	16 (64.0)	9 (56.2)	52 (56.5)
Is feed delivered to your farm on the same load as other farm deliveries?					
Yes	11 (61.1)	16 (48.5)	4 (16.0)	10 (62.5)	41 (44.6)
No	7 (38.9)	17 (51.5)	21 (84.0)	6 (37.5)	51 (55.4)
Is the feed truck usually dirty on arrival (either inside cab or externally) and enters the farm?					
Yes	10 (55.6)	17 (51.5)	6 (24.0)	11 (68.8)	44 (47.8)
No	8 (44.4)	16 (48.5)	19 (76.0)	5 (31.2)	48 (52.2)
Does driver wear coveralls and clean boots each delivery?					
Yes	13 (72.2)	21 (63.6)	6 (24.0)	12 (75.0)	52 (56.5)
No	5 (27.8)	12 (36.4)	19 (76.0)	4 (25.0)	40 (43.5)
Does driver enter farm and pen during delivery?					
Yes	14 (77.8)	3 (9.1)	0 (0.0)	1 (6.2)	18 (19.6)
No	4 (22.2)	30 (90.9)	25 (100.0)	15 (93.8)	74 (80.4)
Do you share your farm attendants with other farms?					
Yes	2 (11.1)	8 (24.2)	5 (20.0)	3 (18.8)	18 (19.6)
No	16 (88.9)	25 (75.8)	20 (80.0)	13 (81.2)	74 (80.4)
Do you share your farm equipment/implements /facilities with other farms?					
Yes	6 (33.3)	4 (12.1)	9 (36.0)	2 (12.5)	21 (22.8)
No	12 (66.7)	29 (87.9)	16 (64.0)	14 (87.5)	71 (77.2)
Do you lend out your boars to other farms?					
Yes	10 (55.6)	20 (60.6)	8 (32.0)	12 (75.0)	50 (54.3)
No	8 (44.4)	13 (39.4)	17 (68.0)	4 (25.0)	42 (45.7)

Although these ASF outbreaks were reported by the Ministry of Agriculture and Natural Resources of the two States, some of the clinical and pathological signs seen (anorexia (71.7%), presence of red loose skin colouration in the ventral abdomen, tips of ears or tail or distal limb (55.4%), dypsnoea (55.4), abnormally increase of water intake and wallowing (54.3%), reddening of the ears (53.3%), sudden death (50%) and abortion (43.5) (Table 2) were suggestive of ASF (Spickler, 2015).

The farm restocking using ASF survivor pigs practised by 61.5% (32/52) of pig farms in the study areas has been vehemently discouraged due to the likelihood of survivors to be carriers and or reservoirs of the virus (FAO, 1998). One of the ways in combating ASF is slaughtering of infected pigs and other pigs at risk (FAO, 1998; FAO, 2010). However, the reasons for using ASF survivor pigs to restock might be due to farmer's financial incapability and non-readiness of the government to give monetary compensation. Compulsory slaughtering without compensation has been advocated to enhance ASF spreads in Nigeria and many African countries (FAO, 1998). Currently, the European Union regulates that pig restocking in ASF ravaged farm without the involvement of ticks could be done 40 days after adequate cleaning and disinfection while a minimum of 6-year quarantine is allowed if vector is involved in the transmission (Spickler, 2015).

Generally, the study showed that even after the ASF outbreak, 21.7% (20/92) pig farmers still keep their pigs under semi-intensive and extensive management systems. This further heightens the risk of the pig population to another infection cycle of ASF and other pathogenic organisms as there is ease of transmission during scavenging activities of such pigs (Babalobi *et al.,* 2007; FAO, 2010). Food and Agriculture organization (FAO) identifies pig rearing under free-range system as one of the hindrances (FAO, 2010) to the control and prevention of ASF outbreak. Also, our study noted that as the control of arthropods (tick, fleas and mites) is important in the control of these infectious agents, 27.2% (25/92) pig farms do not have tick control programme. Trans-stadial, trans-ovarial and sexual transmission of ASF in *Ornithodoros* genus tick have been described (Spickler, 2015), thus a tick control programme is of essence in prevention of tick-borne diseases.

The assumption of ASF free status in a previously ravage communities mainly anchors on maintenance of stringent bio-security in pig farms (FAO, 2010; Fasina *et al.,* 2010). Several bio-security breaches described by Food and Agricultural Organization (FAO) were still observed in the study areas (FAO, 2010). The presence of bio-security information signs at the farm entrance, farm fencing, pest, rodent and tick control programmes, clearing of debris and vegetation, avoidance of feed spills in the farm, prevention of access of animals (birds, wild and domestic), dog, cat, rodents and reptile) to pig and pig feed were yet to be addressed by up to 69% pig farmers in the study area after the ASF outbreak (Table 4b). These features were considered as critical to the prevention of another ASF and other infectious disease outbreak (FAO, 2000; FAO, 2010; Fasina *et al.,* 2010). In addition, the farmer's non-readiness for vaccination of their pigs against classical swine fever and erysipelas is suggestive of a need for sensitization workshop as this pig farmers' attitude could subsequently increase the risk in infection and spread.

The study showed that 37 pig farms do not have carcass disposal point (CDP) (Table 3) among which 32 farms dispose their carcasses by 'throwing it into bush' (19.6%; 18/92), 'selling it' (9.8%; 9/92) and other undisclosed means (5.4%; 5/92). Appropriate carcasses disposal such as burning, burying and use of chemical (as single action or in tandem) is very essential in the prevention against ASF and other infectious agents as dead animal have been reported to be infectious (FAO, 2010; Spickler, 2015). Even if the cause of death is known, indiscriminately disposed carcasses can be accessed by free range domestic and wild animals while the sale of carcasses constitutes high public risk (FAO, 2010). It has been suggested that the location of CDP (in this study, 59.8% of the pig farms has CDP) either on-site or off-site should be well considered to avoid future outbreak especially when ASF and other contagious disease is to be prevented on the farm site (Miller & Flory, 2018).

The role of quarantine in any livestock farms is expected to be taken seriously more so in a stocking and restocking activities post-outbreak of any disease. Unfortunately, 46.7% (43/92) pig farms in these ASF devastated locations still do not have quarantine facility. They were still engaged in buying and adding new pig stock directly into their regular pens. Meanwhile, pig farms that have this facility (98%; 48/49) only quarantine new pigs for < 3 weeks. This short quarantine period is in disagreement with FAO's recommendation of a minimum of 30 days (FAO, 2010). It is expedient to consider the incubating periods of some infectious pathogens (including ASF) which can be more than 21 days (Spickler, 2015), thus the addition of unsuspected infected pig into the herd

can precipitate unwanted outcome. Also, the pig farmers (46.7%; 43/92) in the study area did not seem to understand the essence of laboratory testing for a newly acquired animal before its inclusion in the farm. A newly acquired animal could be incubating infectious agents and early laboratory testing might reveal such. This aid in making appropriate decision (FAO, 2010). Furthermore, this study showed that 40.2% (37/92) of pig farmers do not consider having isolation pen as important thereby enhancing ease in disease transmission within herd (Babalobi *et al.,* 2007). Aside advocating for availability of quarantine and isolation facilities, the distances to the regular pens should be well considered as closeness could warrant uncoordinated unilateral movement. Based on socio-demographic data of the pig farmers, the study revealed that male dominated the pig farming activity (most active) than female ones and this was found to be significant at p= 0.0204 between the two states considered. This is in agreement with Saka *et al*. (2010) who reported higher male activity in pig farming than the female counterpart. The rigor and energy demand in pig farming may explain this observation. With 57.6% pig farmers having tertiary education, it would have been expected that the pig farm practise would be at the best. Unfortunately, this is not with more than 50% of the pig farms studied.

In conclusion, this study was able to identify several loopholes that could easily facilitate ASF (other infectious agents) spread in time and space in these previously ASF ravaged pig farms in the study areas. This might have resulted from the pig farmers' ignorance and inadequate or lack of follow up by regulating bodies mandated to educating and enforcing compliance to standard pig farming practise. Aside the fact that pig farming has its socioeconomic contributions, they are very important host of zoonotic pathogens (like influenza A virus, salmonella) of humans, thus, its practise has to be strictly regulated to maintain public health safety.

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Conflicts of Interest

The authors declare no conflict of interest.

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