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Biosecurity and readiness of smallholder pig farmers against potential African Swine Fever outbreak and other pig diseases in Baybay City, Leyte, Philippines

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Abstract

Preventing African Swine Fever (ASF) outbreaks require an active involvement of pig growers as they are in the frontline of detection, notification, and the application of strict biosecurity measures. The Eastern Visayas (Region VIII) in Central Philippines is still free of ASF but the risk can be remarkable given the high volume of pigs that enter in this region as a market hub to large pig producers both coming from Luzon (north) and Mindanao (south). This study was conducted to better understand the readiness and biosecurity practices of smallholder pig farmers who comprise most of the pig growers in the City of Baybay, Leyte. Using multiple correspondence analysis (MCA) and agglomerative hierarchical clustering (AHC) technique of data from 350 pig farmer-respondents, our study found several areas in pig raising activities that need to be highlighted. While pig farmers were generally aware of the threat posed by ASF and have relatively good biosecurity practices, only 32.90% were convinced that the City of Baybay is prepared in the case of an ASF outbreak. Moreover, the importance of vaccination, footbath, and controlling swill feeding need to be emphasized (Cluster 2, 58.29%). More efforts should be directed towards preparing and training pig farmers on disease monitoring and surveillance and improving further its biosecurity practices with special focus on bioexclusion. Similar studies should be conducted to nearby local government units particularly those located near entry and exit borders of the Eastern Visayas region.

Keywords: African Swine Fever; biosecurity; backyard pig farmers; Baybay City.

1. Introduction

The case of African Swine Fever (ASF) in Asia has been unprecedented with outbreaks occurring around many countries, significantly impacting animal health and welfare, the agricultural economy and food security (Costard *et al.*, 2009; FAO, 2020; Tian and von Cramon-Taubadel, 2020). While ASF does not pose direct risk to human health, its highly contagious and fatal characteristics affecting both young or old, and domestic and the wild boar population could lead to severe devastation of the pig industry (Costard *et al.*, 2009; Costard *et al.*, 2013). African Swine Fever has ravaged the swine industry of both the Western (1960–1995) and Eastern Europe (2007–2018) (Cwynar *et al.*, 2019; Lu *et al.*, 2020), and has caused more than a million pig deaths in

China since severe outbreaks occurred in 2018, signalling fear and unprecedented spread among other countries in Asia (Estienne, 2019). Inevitably enough, many Asian countries have been affected since, including Mongolia in January, Vietnam in February, Cambodia in April, North Korea in May, Laos in June, Myanmar in August, and South Korea in September, among others including the Philippines as the 9th country affected (Pig Progress, 2019; Estienne, 2019; FAO, 2020; Kim *et al.*, 2020; Parrocha, 2020). Record breaking increase in the number of countries affected has continued to occur since 2005 to 2018 (Rozstalnyy and Plavšić, 2019). Since the ASF DNA virus is complex being unusually related to other viruses, no effective vaccine has yet been developed (Costard *et al.*, 2013), thus

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calling for a comprehensive approach to contain and control its impact.

Due to the potential catastrophic impact of ASF on the country's swine industry, the President of the Philippines signed Executive Order No. 105 in February 21, 2020 "creating a national task force to prevent the entry of animal-borne diseases, contain and control the transmission thereof, and address issues relating thereto", and mandating the "Department of Agriculture, through the Bureau of Animal Industry to control and eradicate dangerous communicable diseases of domestic animals" (*Official Gazette*, 2020). Towards the end of 2020, The Philippines has seen several thousands of deaths and/or mass culling of pigs to control the spread of ASF particularly in Luzon in the north but has also affected Mindanao in the southern part of the country (*Parrocha*, 2020). The Philippines is among the top pork producers worldwide with a close to ₱200 billion pig industry of about 12.7M pigs (*DOST-PCAARRD*, 2016; *PSA*, 2020). Of this about 65% is considered backyard or those pigs normally raised by smallholder farmers with seemingly limited access to feed supply, equipment, and facilities, and veterinary health resources. The practice of swill feeding is not uncommon given the several and widely available sources including kitchen leftovers, hotels, restaurants, and the like.

The Eastern Visayas Region (Region VIII) in central Philippines where this study was conducted is still free of ASF but the risk is high considering the volume of pigs that arrive in this region both coming from Luzon (north) and Mindanao (south) pig producers. Thus, the Department of Agriculture and authorities in the region have prompted significant steps to prevent the entry of ASF including the release of relevant Executive Orders from different provincial governments to monitor and/or ban entry of live pigs, pork and pork products from different entry/exit points as well as timely reporting of pigs that manifest ASF-like symptoms (*Quirante*, 2019). The Bureau of Animal Industry has also earlier rolled out the "1-7-10 Protocol" for culling management, surveillance, and reporting, as well as the BABES campaign which stands for: Ban pork imports from confirmed ASF-affected countries; Avoid swill feeding; Block entry at major seaport and airports, especially international ports; Educate our people; and lastly, Submit hog blood samples (*DA Communications Group* 2019; *Meniano*, 2019). Region VIII is a potential market from among large pig producers outside of the region considering its low pig inventory in the country (3.2%;

PSA, 2019). The demand for pork in the Province of Leyte is substantially favourable as Leyte accounts for most slaughtered pigs within the region (*PSA*, 2018).

Preventing further spread of ASF from the initially affected areas appears to be the core strategy to contain the economic losses caused by ASF (*GAIN*, 2019). The Food and Agriculture Organization (FAO) through the Agriculture and Consumer Protection Department emphasizes early reaction, detection and notification including the application of strict biosecurity measures. This also includes improved husbandry practices, disinfection and good surveillance and monitoring of live pigs being transported (*FAO*, 2020). Stringent compliance with biosecurity measures and cooperation with government initiatives are key strategies to prevent introduction and contain the impact of ASF. The aim of this study was to determine and understand the current situation, readiness and examine the biosecurity practices of backyard pig farmers within the City of Baybay, Leyte, Philippines. Results of this study could influence decision makers both as pig farm owners and government officials in facing the challenges posed by disease outbreaks.

2. Materials and methods

Location of the study and sampling procedures

The study was conducted between September 2019 to February 2020 about a year after the significant outbreak of ASF occurred in the country. The City of Baybay in the Province of Leyte, is the second largest city within the Eastern Visayas region (Region VIII) composed of at about 92 barangays, 24 of which are urban and 68 are rural, and a home to a population of about 110,000 (*PSA*, 2017). There are only a few commercial pig farms making backyard or smallholder type of pig production a major livestock activity covering about 11,000 pig population. Following recommended sampling procedures, at least 350 pig farmers were required at 95% level of confidence and 5% margin of error after considering about 4,100 current backyard pig raisers (*The Research Advisors* 2006; *Fosgate*, 2009; *Andico and Peña*, 2019). The farmer respondents were randomly selected and proportionally allocated per barangay from a given population of backyard pig raisers provided by the local agriculture office. The study was approved by the Student Research Committee of the College of Veterinary Medicine, Visayas State University.

Survey questionnaire and conduct of interview

A systematic questionnaire was constructed and modified following previous research by Andico and Peña (2019) including earlier studies on similar topic (Ribbens et al., 2008; Alawneh et al., 2014) (Appendix). Among the questions included were the pig farmers’ socio-demographic information, pig production and health management, biosecurity practices, and farmers’ knowledge of ASF. The questionnaire was constructed in English and translated into the local dialect (Baybayanon/Cebuano) for ease and convenience during the one-on-one interview at the respective residence of the farmer respondents with prior verbal consent. Any information that has the potential to identify the farmer-respondent was handled with confidentiality and was not included in the analysis to protect the privacy of respondents. In the event the first respondent was not available or refused to participate, the next available backyard pig raiser closest to that respondent was interviewed instead. The actual interview completed about 15 minutes per respondent.

Data management and statistical analysis

All data were encoded in and analyzed using Microsoft Office Excel with XLSTAT Basic (version 2020.1.3) installed for multiple correspondence analysis (MCA), agglomerative hierarchical clustering (AHC) and parallel coordinates plots (PCP), following procedures found in the XLSTAT Support Center and as previously described (Andico and Peña, 2019). From the questionnaire, variables relating to knowledge on ASF, and biosecurity practices were analyzed separately. Descriptive statistics on farmers’ socio-demographics and pig production general characteristics were also generated, accordingly.

3. Results and discussion

All farmers who were initially included in sampling responded providing us with sufficiently robust data to proceed with the evaluation and characterization of the different aspects of the level of preparedness and biosecurity practices of backyard pig farmers against potential ASF outbreak and other swine diseases in Baybay City, Leyte. Apparently, at least three quarters of pig farmers signified awareness of ASF (82.30%) and have correctly identified ASF as a viral disease (74.90%, Table 1). Almost all the respondents are aware that ASF is already present in the country and that a vaccine for prevention does not exist, thus a major concern if an outbreak occurs. Interestingly, despite attendance to seminar on ASF, almost half of the farmer respondents were convinced that the city is not likely prepared in the case of an ASF outbreak (Table 1).

Table 1
Summary statistics of the farmer-respondents’ knowledge about the African Swine Fever (ASF)

Variable	Categories	Frequency	Proportion (%)
Know about ASF	No	62	17.70
	Yes	288	82.30
Cause of ASF	Air	1	0.00
	Bacteria	60	17.10
	Food	2	0.01
	No idea	25	7.10
	Virus	262	74.90
Vaccine available	No	324	92.60
	Yes	26	7.40
Present in Philippines	No	34	9.70
	Yes	316	90.30
City is prepared	No	90	25.70
	Not so	145	41.40
	Yes	115	32.90
A concern	No	20	5.70
	Yes	330	94.30
Attended ASF seminar in the past 6 months	No	317	90.60
	Yes	33	9.40

n=350; ASF, African Swine fever.

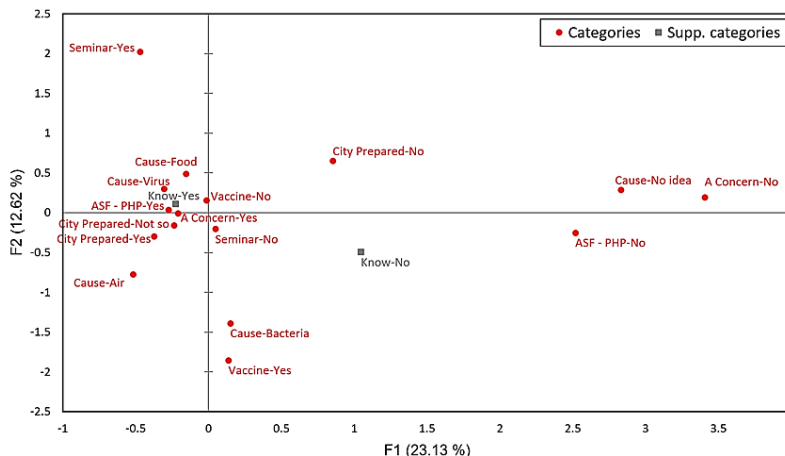


Figure 1. Multiple-correspondence analysis solution of the farmer-respondents’ knowledge about the African Swine Fever (ASF).

Figure 1 shows the MCA solution for the variables regarding actions taken by the respondents to control and prevent pig diseases. Briefly, those respondents who responded having knowledge of ASF were the same respondents who answered correctly in terms of the cause, and the presence, including participation on a seminar about ASF (upper left quadrant), while, those who responded being not aware of ASF have not attended any seminar on ASF nor were aware of the presence of ASF in the Philippines (lower right quadrant).

Following AHC, six clusters were generated characterizing the farmer-respondents' knowledge about ASF. Almost half (46.70%) belong to Cluster 1 (black) and is characterized by pig farmers who have signified knowledge about ASF, its cause, presence in the Philippines, that it is a concern, but is not so convinced that the city is prepared of potential ASF outbreak (Figure 2A). Almost similar features appear to characterize Cluster 3 (blue, 33.43%) except that these respondents believed that ASF is caused by bacteria and that the city is prepared despite having not attended any seminar on ASF (Figure 2B).

Figure 3 provides summary statistics of some pertinent biosecurity practices of backyard pig farmers. Despite the remarkably high proportion of farmers who provide pens for their pigs, there are still some who do not (4.90%). While deworming is heavily practiced, the opposite was true with vaccination. Many pig farms are freely accessible to visitors, no effective footbath, nor perimeter fence provided with only less than 10% of the pig farms were at least 200m away from the household. About 30% still practiced swill feeding and a sizable portion do not necessarily own veterinary materials for use on their farms.

Figures 4 and 5A show the MCA solution, and dendrogram generated by AHC of the farmer-respondents' biosecurity practices and pig health management in Baybay City, Leyte, respectively. Of the three clusters generated, C2 (green) is by far the largest (58.29%), followed by Cluster 1 (blue, 38.00%) and finally Cluster 3 (red) at 3.71%. The biosecurity practices between these clusters are plotted accordingly in Figure 5B which highlights Cluster 1 (38%) with good biosecurity practices.

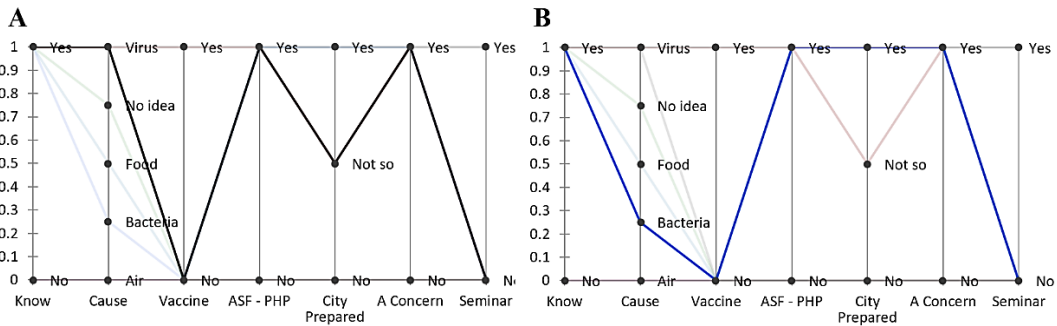


Figure 2. Parallel coordinate plots highlighting Cluster 1 (2A, black, 46.7%) and Cluster 3 (2B, blue, 33.43%) showing six clusters of farmer-respondents' knowledge about African Swine Fever (ASF).

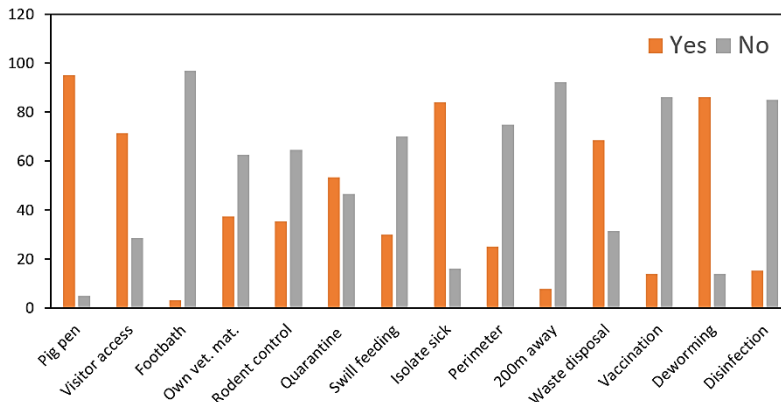


Figure 3. Summary statistics on biosecurity practices of smallholder pig farmers.

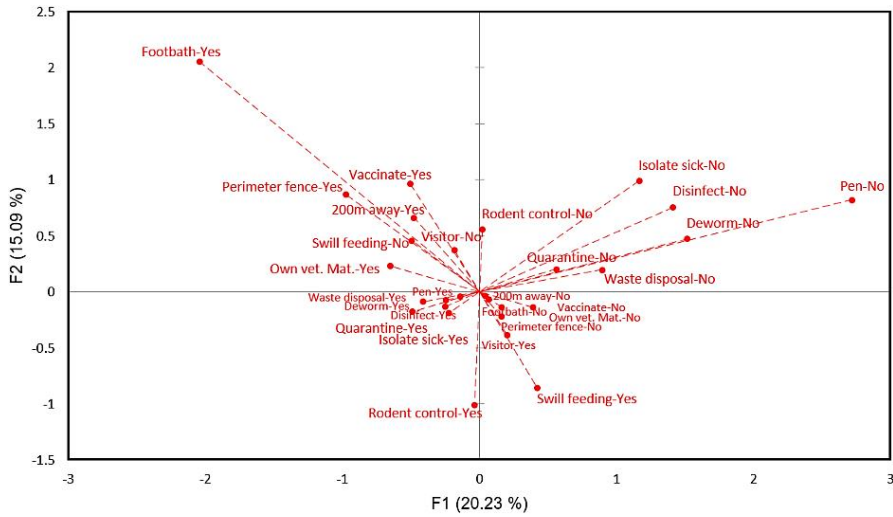


Figure 4. Multiple-correspondence analysis solution of the farmer-respondents' biosecurity practices and pig health management.

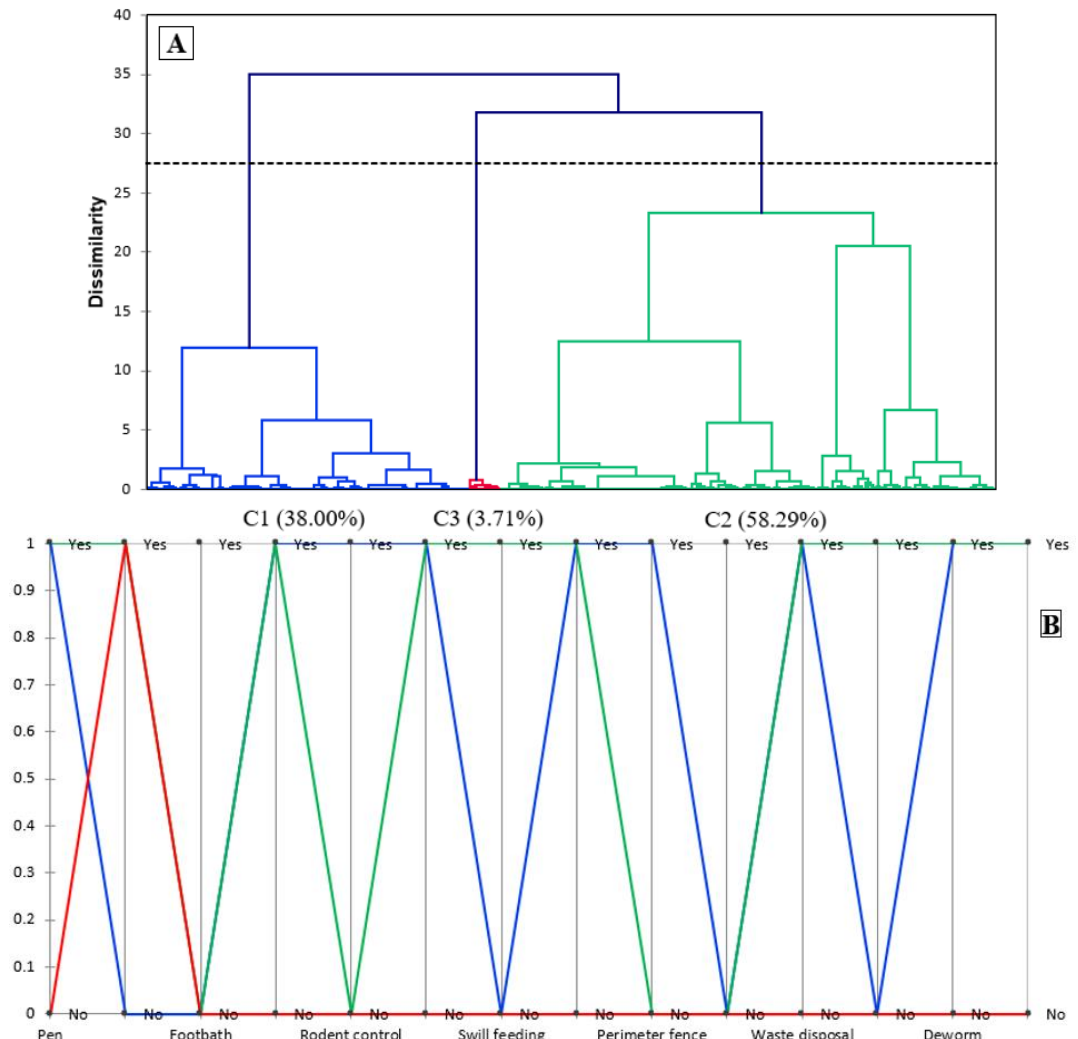


Figure 5. Dendrogram generated by AHC (A) and parallel coordinate plots (B) describing three clusters (C1= blue, 38.00%; C2= green, 58.29%; & C3= red, 3.71%) of the farmer-respondents' biosecurity practices and pig health management.

Table 2

Demographics and general characteristics of backyard pig farmer-respondents

Demographics	Categories	Frequency	Proportion (%)
Gender	Female	201	57.40
	Male	149	42.60
Civil status	Married	300	85.70
	Single	29	8.30
	Widowed	21	6.00
Educational level	College	86	24.60
	Elementary	71	20.30
	Highschool	151	43.10
	None	2	0.01
Purpose of raising pig	Vocational	40	11.40
	Hobby	78	22.30
	Primary source	49	14.00
	Secondary source	223	63.70
Seminar on pig raising	No	291	81.70
	Yes	65	18.30
Receive assistance	Agri-vet Technician*	236	67.40
Membership in pig raising organization	No	318	90.90
	Yes	32	9.10

* for emphasis.

Table 2 provides summary statistics of the demographics of the farmer-respondents. Apparently, there were more females than males, and most of the pig raisers are married. Nearly half of the farmer-respondents (43.10%) have reached high school while 63.70% answered secondary source of income as the purpose of pig raising. Only a small portion have attended seminar on pig raising (18.3%) in the last six months, in the same way as membership in a swine raising organization (9.10%). In addition, the average age of the farmer-respondents was 45.67 ± 0.64 with about 8.21 ± 0.39 years of experience in raising pigs. On Table 3 is a short description of the farming practices by farmer-respondents. Nearly half of the respondents (48.31%) raise a combination of different classes of pigs with a majority using a mixed breed (84.30%). A few farmers raise boars for artificial insemination or selling semen. Good record keeping does not exist in 76% of the farms. The average number of pigs raised by each pig farmer is 5.24 ± 0.30 heads.

The potential devastation that ASF may cause to the pig industry requires an active involvement of pig growers in the community as they are in the frontline of detection, notification, and the application of strict biosecurity measures. Moreover, as pig farmers have different husbandry and health management practices, it is imperative that the government should take a proactive role in surveillance and monitoring of hygiene, proper waste

disposal, swill feeding, and the conduct of related seminars on best practices and pig diseases, among others, to raise awareness within the community. In the case of the City of Baybay, Leyte, at least a long-standing city ordinance (M.O. No. 004 2004) already exists highlighting systematic and ecologically sustainable programs to be adopted in all pig raising projects. However, how this ordinance is being enforced or practiced by concerned stakeholders may need to be revisited.

Table 3

General characteristics of pig farmer raising activities

Farming practices	Categories	Frequency	Proportion (%)
Type of Pig	Boar	2	0.56
	Combination	165	48.31
	Fatteners	98	27.24
	Sow	85	23.87
Breed	Duroc	14	4.00
	Landrace	9	2.60
	Landrace/Duroc	2	0.06
	Large White/duroc	1	0.03
	Large White	13	3.70
	Mixed	295	84.30
	Native	9	2.60
	Pietrain	7	2.00
Record keeping	Combination	58	16.6
	Feed consumption	22	6.3
	Health/Vaccination	3	0.01
	Mortality/Morbidity	1	0.00
Raise boar/s	None	266	76.00
	No	328	93.70
Conduct AI/Sell semen	Yes	22	6.30
	No	334	95.40
	Yes	16	4.60

AI = artificial insemination.

Results of our current study demonstrate several key areas in pig raising activities that need to be reviewed and LGU's active support is important not only to improve production targets but also increase the level of preparedness among backyard pig farmers in the case of disease outbreaks like the ASF. While ASF could drastically affect large and commercial pig production businesses (Costard *et al.*, 2009), significant losses could easily railroad small pig producers commonly known in the Philippines as backyard pig farmers apparently due to poor preventive/control measures and biosecurity in this type of production (Edelsten and Chinombo, 1995; Costard *et al.*, 2009). As ASF can wipe out a significant fraction of the pig population, the risk it poses against food security can be difficult to imagine. Pork is still one of the most widely eaten meat globally and many

countries rely heavily on the pig production trade providing significant contribution to many countries' gross domestic product. In 2011, when an ASF outbreak occurred in Isoka district of Zambia in Africa, the pig population decreased by at least 50% (Komba *et al.*, 2014), let alone the possible rise in the price of locally produced pork as a result of reduction in pork supply (McOrist, 2019). Thus, vulnerable regions however small should engage in programs to empower both animal professionals and down to common pig growers to embrace awareness and readiness against potential disease outbreaks.

Interestingly, most pig farmers appear to be clearly knowledgeable of ASF along its presence as an active threat in the Philippine swine industry (Table 3). It has been noted that most of the farmers have access to TV, newspapers, and related materials as sources of information about the ASF. This could be a good start to strengthen further the implementation of relevant programs for the prevention and control of swine diseases. Since, nearly half of the farmer respondents represented those cluster who are not so convinced that the City of Baybay is prepared in the case of an ASF outbreak (46.7%; Figure 2A), the LGU concerned may take this as a priority to engage in different education campaigns to heighten the promotion of ASF awareness within the locality particularly among those engaged in pig farming. When the first ASF case was reported in the Philippines in about September 2019 (McOrist, 2019; WAHID, n.d.), samples require further confirmation so that appropriate measures can be applied. Moreover, this is compounded by the fact that the rate of spread depends on multiple factors many of which are yet to be understood fully (Schulz *et al.*, 2019).

In terms of pertinent biosecurity practices of backyard pig farmers, the practices that need to be highlighted include vaccination, provision of a suitable footbath, perimeter fence, rodent control, and most importantly swill feeding. Nevertheless, it was notable to observe that the farmer-respondents have good biosecurity practices in general. However, there are still about 5% who do not provide proper shelter for their pigs (Figure 3) while the importance of vaccination, swill feeding and the provision of a footbath where possible need to be emphasized for Cluster 2 (58.29%; Figure 5A) of pig farmers. In fact, swill feeding alone is still practiced by closed to 30% (Figure 3) which is quite alarming considering that the introduction of ASF into the country could have likely

started from contaminated meat leftovers and waste food products fed to backyard pigs (Beek, 2019). This is almost similar in the case of ASF outbreak in Brazil in 1978 which was suspected to be due to food waste introduced by tourists from infected countries (Lyra, 2006). While biosecurity in general should be attainable and reasonable, there are complex factors that need to be considered for effective implementation particularly when applied to field settings (Anderson, 2010). There are practical variables including but not limited to budget, equipment, facilities, educational background, and personnel's understanding and attitude against disease spread and prevention (Anderson, 2010; Simon-Grifé *et al.*, 2013). In terms of attitude toward implementation of biosecurity programs, it appears that the economic cost and benefits associated with implementation of such programs need to be clear in the first place and how these measures play along with mandatory rules (Gunn *et al.*, 2008). In fact, one of the reasons pig farmers and traders may have a negative attitude and less cooperation with authority towards biosecurity measures is the associated costs.

It is quite typical for backyard pig raising activities to be considered as a secondary source of income as demonstrated in the result of the study (63.70%; Table 2). Many of these farmers may still be engaged in other farming activities while the limited land and the capital requirements may also prohibit them to engage in commercial production. Given the average age of farmers at 45.67 ± 0.64 years, this was apparently reflected also with their relatively long experience (8.21 ± 0.39 years) in pig raising activities. This could be taken as an advantage by the LGU as these farmers demonstrate their experience and skills in pig raising given their long engagement. Quite surprisingly though, only a small portion of the farmers have answered attendance to pig raising seminars as well as membership in swine raising organization (Table 2). This should be promoted as participation and involvement to relevant education activities and organization is both helpful and advantageous (Andico and Peña, 2019). The problem of record keeping in the farm also needs to be addressed as most pig farmers (76%) do not keep records of their farming activities (Table 3). A portion of farmers are also engaged in maintaining a boar allowing them to sell semen which again could funnel the transmission of diseases (Table 3). Overall, it appears that bottomline measures directed towards early detection, timely

reporting, rapid response and coordination of various stakeholders at all levels, on top of good animal husbandry, health management and biosecurity (Swai and Lyimo, 2014; Yun, 2020) must be given priority to ensure readiness in the case of potential ASF outbreaks and other swine diseases of economic importance.

4. Conclusions

Pig farmers in Baybay City, Leyte are mostly aware of the African Swine Fever as a viral disease present in the country. However, despite the seemingly acceptable biosecurity practices of pig farmers with close to 95% who signified ASF as a concern or threat to the pig industry and food security, only a third believes that the City is prepared to a potential ASF outbreak. Swine stakeholders of the city should take into consideration efforts geared towards preparing and training pig farmers on disease monitoring and surveillance, and improving further its biosecurity practices perhaps with special focus on bioexclusion in order to prevent the entry of the ASF virus into the city. Similar studies should be conducted to nearby cities and municipalities (local government units) particularly near entry and exit borders of the Eastern Visayas region.

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References

Alawneh, J.I.; Barnes, T.S.; Parke, C.; *et al.* 2014 Description of the pig production systems, biosecurity practices and herd health providers in two provinces with high swine density in the Philippines. *Preventive Veterinary Medicine* 114: 73-87.

Anderson, DE. 2010. Survey of biosecurity practice utilized by veterinarians working with farm animal species. *Online Journal of Rural Research and Policy* 5(7): Art.6.

Andico, W.; Peña, S.T. Jr. 2019. Biosecurity practices in high throughput Philippine backyard pig herds: a multiple correspondence analysis. *International Journal of Veterinary Science* 8(4): 316-323.

Bernardes, T.C. 2020. Assessing the level of preparedness against potential African Swine Fever outbreak and other swine diseases among backyard pig raisers in Baybay City, Leyte. Visayas State

University, Baybay City, Leyte, Philippines. Undergraduate Thesis.

Costard, S; Mur, L.; Lubroth, J.; *et al.* 2013. Epidemiology of African Swine Fever virus. *Virus Research* 173(1): 191-197.

Costard, S.; Wieland, B; Glanville W.; *et al.* 2009. African Swine Fever: how can global spread be prevented? *Philosophical Transactions of the Royal Society B: Biological Sciences* 364(1530): 2683-2696.

Cwynar, P.; Stojkov, J.; Wlazlak, K. 2019. African Swine Fever status in Europe. *Viruses* 11(4): 310.

DA Communication Group. 2019. DA-CMTF Bulletin No. 5: On vigorously enforcing “1-7-10 Protocol” to manage, contain, and control suspected swine disease; result of confirmatory test. Department of Agriculture, Philippines.

DOST-PCAARRD. 2016. Philippine pork to the world. Livestock Research Division. Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development. Department of Science and Technology, Philippines. Available at: <http://www.pcaarrd.dost.gov.ph/home/portal/index.php/quick-information-dispatch/2681-philippine-pork-to-the-world>.

Edelsten, R.; Chinombo, D. 1995. An outbreak of African Swine Fever in the southern region of Malawi. *Revue Scientifique et Technique-Office International des Epizooties* 14(3): 655-666.

Estienne, M.J. 2019. An update on African Swine Fever and its effects on pork production. Virginia Cooperative Extension. Available in: https://www.pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/APSC/apsc-162/APSC-162.pdf

FAO - Food and Agriculture Organization. 2020. ASF situation in Asia update. Food and Agriculture Organization. Available at: http://www.fao.org/ag/againfo/programmes/en/empires/ASF/situation_update.html

Fosgate, G.T. 2009. Practical sample size calculations for surveillance and diagnostic investigations. *Journal of Veterinary Diagnostic Investigation* 21(1): 3-14.

GAIN. 2019. African Swine Fever (ASF) Confirmed in the Philippines., Global Agricultural Information Network (GAIN) Report Number: RP1917. USDA Foreign Agricultural Service. 5 pp.

Gunn, G.J.; Heffernan, C.; Hall, M.; Mcleod, A. 2008. Measuring and comparing constraints to improved biosecurity amongst GB farmers, veterinarians and the auxiliary industries. *Preventive Veterinary Medicine* 84(3-4): 310-323.

Kim, H-J.; Cho, K-H.; Lee, S-K.; *et al.* 2020. Outbreak of African Swine Fever in South Korea, 2019. *Transboundary and Emerging Diseases* 67(2): 473-475.

Komba, E.; Karimuribo, E.; Kanemanema, M. 2014. Socio-economic impact of African Swine Fever outbreak of 2011 and its epidemiology in Isoka District of Zambia. *Tanzania Veterinary Journal* 29(1): 39-47.

Lu, G.; Pan, J.; Zhang, G. 2020. African Swine Fever virus in Asia: Its rapid spread and potential threat to unaffected countries. *Journal of Infection* 80(3): 350-371.

Lyra, T. 2006. The eradication of African Swine Fever in Brazil, 1978-1984. *Revue Scientifique et Technique (International Office of Epizootics)* 25(1): 93-103.

McOrist, S. 2019. ASF hits hard at farms in the Philippines. *Pig Progress*. Available at: <https://www.pigprogress.net/Health/Articles/2019/10/ASF-hits-hard-at-farms-in-Philippines-480956E/>.

Meniano, S. 2019. Eastern Visayas free from swine fever. Department of Agriculture-8. Tacloban City, Philippines.

Official Gazette. 2020. Executive Order No. 105: Creating a National Task force to Prevent the Entry of Animal-Borne Diseases, Contain and Control the Transmission Thereof, and Address Issues Relating Thereto. Republic of the Philippines.

Parrocha, A. 2020. Duterte creates national task force vs. ASF. Department of Agriculture, Philippines.

- PSA - Philippine Statistics Authority. 2017. Special Release: Highlights of the 2015 census results for the City of Baybay. Philippines Statistics Authority, Leyte Provincial Statistical Office, Tacloban City, Philippines. 6 pp.
- PSA - Philippine Statistics Authority. 2018. Livestock and poultry statistics of the Philippines (2013-2017). Philippines Statistics Authority, Quezon City, Philippines. 183 pp.
- PSA - Philippine Statistics Authority. 2019. Swine production in Eastern Visayas increases by 2.2 percent. Philippine Statistics Authority, Region VIII - Eastern Visayas. Available at: <http://rsso08.psa.gov.ph/article/swine-production-eastern-visayas-increases-22-percent#sthash.vEh170rE.76EYws10.dpbs>
- PSA - Philippine Statistics Authority. 2020. Swine situation report, January-March 2020. Philippine Statistics Authority. Available at: <https://psa.gov.ph/content/swine-situation-report-january-march-2020-0>
- Pig Progress. 2019. Updated: ASF in Philippines, outbreaks confirmed near Manila. (Ed. Beek V). Pig Progress. Available at: <https://www.pigprogress.net/Health/Articles/2019/9/ASF-Philippines-First-outbreaks-confirmed-near-Manila-470420E>
- Quirante, N.; 2019. DA8 mobilizes EV LGUs vs African Swine Fever. Department of Agriculture-8. Tacloban City, Philippines.
- Ribbens, S.; Dewulf, J.; Koenen, F.; *et al.* 2008. A survey on biosecurity and management practices in Belgian pig herds. Preventive Veterinary Medicine 83(3-4): 228-241.
- Rozstalnyy, A.; Plavšić, B. 2019. Strategic challenges to global control of African Swine Fever. 87th General Session. World Assembly. World Organization of Animal Health.. Paris, 26-31 may 2019. 15 pp.
- Schulz, K.; Conraths, F.J.; Blome S.; *et al.* 2019. African Swine Fever: Fast and Furious or Slow and Steady? Viruses 11(9): 866.
- Simon-Grifé, M.; Martin-Valls, G.E.; Vilar-Ares, M.J. *et al.* 2013. Biosecurity practices in Spanish pig herds: perceptions of farmers and veterinarians of the most important biosecurity measures. Preventive Veterinary Medicine 223-231.
- Swai, E.; Lyimo, C.; 2014. Impact of African Swine Fever epidemics in smallholder pig production units in Rombo district of Kilimanjaro, Tanzania. Livestock Research for Rural Development 26(2): Article# 32.
- Tian, X.; von Cramon-Taubadel, S. 2020. Economic consequences of African Swine Fever. Nature Food 1(4): 196-197.
- The Research Advisors. 2006. Sample size table. Available at: <https://www.research-advisors.com/tools/SampleSize.htm>
- WAHID - World Animal Health Information Database (n.d.). African swine fever, Philippines. World Animal Health Information Database. World Organisation for Animal Health (OIE). Available at: https://www.oie.int/wahis_2/public/wahid.php/Reviewreport/Review?page_refer=MapFullEventReport&reportid=31677
- Yun, C-H. 2020. Editorial - Unforeseen enemy: African Swine Fever. Asian-Australasian Journal of Animal Sciences 33(1): 1-3.

Appendix. Questionnaire form

Survey Questionnaire No. _____
Name: _____ Barangay: _____

I. Socio-demographic variables

1. Age: _____
2. Gender: M F
3. Civil status: Single Married Widowed
4. Educational level: None Elementary (Grade: _) High School (Year: _) Vocational College (Year: _____)
5. Occupation: _____
6. How many years have you raised pigs? _____
7. Why do you raise pigs? Primary source of income Secondary source of income Hobby
8. Have you attended seminars related to pig production, biosecurity management and common swine diseases in the last six months? Yes No
9. What is the profession of the person whom you frequently asked questions regarding pig management? Veterinarian Agri-vet technician/store person Animal Technician DA personnel Others (pls. specify) _____
10. Are you a member of any Hog Raising Association? Yes No

II. Questions about ASF

1. Do you know what African Swine Fever (ASF) is all about? Yes No
2. What causes ASF disease? bacteria virus others _____
3. Have you attended any seminar about ASF? Yes No
4. Who conducted the seminar about ASF? Provincial Veterinarian Other Gov't Agriculturist/Employee Private personnel (BMEG, Pigrolac, Others: please specify: _____)
5. Is there a vaccine for ASF? Yes No
6. Is there ASF in the Philippines? Yes No
7. Do you think ASF can affect other pigs? Yes No
8. Do you think ASF can affect other animals other than pigs? Yes No
9. Do you think ASF can affect humans? Yes No
10. Do you think Baybay City is prepared with an ASF outbreak? No Not so Yes
11. Is ASF a serious concern for the pig industry? Yes No
12. Other sources of ASF information: TV Radio Newspaper Others: please specify: _____

III. Production status

1. How many pigs are you raising? _____
2. What type of pigs do you raise? Breeder (Sow) Fatteners Breeder Boar Combination
3. What is/are the breed of your pigs? Purebreed (pls. specify _____) Mixed breed Native
4. What kind of records do you usually keep or note in managing pigs? Feed consumption Mortality/morbidity rate Health/vaccination records Combination None Others (pls. specify) _____
5. Do you have a boar? Yes No
6. Do you do artificial insemination (AI) service and/or sell semen? Yes No

IV. Health management

1. Are you using artificial insemination to breed your pigs? Yes No Not applicable (fattening only)
2. Do you wean your piglets only at the age of 1 month or less? Yes No Not applicable (Fatteners only). If yes, at what specific age? _____
3. Are you practicing tail docking to your piglets? Yes No Not applicable (Fatteners only). If yes, at what specific age? _____
4. Are you practicing needle teeth clipping to your piglets? Yes No Not applicable (Fatteners only). If yes, at what specific age? _____
5. Are you practicing castration to your male piglets? Yes No Not applicable (Fatteners only). If yes, at what specific age? _____
6. Is the feeds given to the pigs mainly commercial feeds? Yes No
7. Is your pigpen properly roofed? Yes No. If yes, what is the roof made of? _____
8. Is your pigpen's water source coming from water district? Yes No If no, what is the source of water? _____
9. Is proper flooring applied on your pigpen? Yes No If yes, what is it made of? _____
10. Is your piggery located at least one kilometer away from any piggeries near your area? Yes No
11. How often do you bathe your pigs? once a day at least 3 times a week once a week none
12. Do you deworm your pigs? Yes No If yes, how often? _____
13. Are you giving Iron supplement to your pigs? Yes No If yes, how often? _____
14. Are you giving vitamin and/or mineral as supplement to your pigs? Yes No If yes, How often? _____

V. Biosecurity practices

1. Do you have pens provided to your pigs? Yes No What is your pen predominantly made of? _____
2. Where do you get your replacement stock/pigs? Piggeries within Leyte From other piggeries outside Leyte Own production If outside Leyte, please specify: _____
3. Do you permit visitors to enter your piggery anytime? Yes No
4. Are all persons obliged to shower before entering the piggery? Yes No
5. Do you have footbath at the entrance of your piggery? Yes No
6. Do you wear boots when entering your piggery? Yes No
7. Do you have separate clothes for used in your piggery purposes only? Yes No
8. Do you have your own veterinary materials (e.g. syringe, medicines) for your own piggery? Yes No
9. Do you share your veterinary materials with other piggery owners or vice versa? Yes No
10. Do birds have access to your piggery? Yes No
11. Are dogs/cats allowed to enter your piggery? Yes No
12. Are you doing regular insect control in your piggery? Yes No If yes, what is your method of control? _____
13. Are you doing regular rodent control in your piggery? Yes No If yes, what is your method of control? _____
14. Do you have a quarantine area for the newly acquired pigs before it will be put in the pen together with other pigs? Yes No
15. Are you raising other livestock aside from pigs? Yes No If yes, what are those? _____
16. Are you raising pet animals? Yes No If yes, what are those? _____
17. Do you practice swill feeding to your pigs? Yes No
18. Do you isolate sick pigs from other pigs just in case? Yes No
19. Do you provide a perimeter fence in your piggery? Yes No If yes, what is its type of fence? _____
20. Do you vaccinate your pigs? Yes No If yes, what is its vaccines do you give? _____
21. Do you practice proper waste disposal in your piggery? Yes No
22. Do you bury/burn dead pigs? Yes No
23. Do you disinfect your piggery before loading new batch of pigs? Yes No
24. Is there a drainage system found on your piggery? Yes No
25. Do you practice "All-in-all-out" system? Yes No
26. Is your piggery located at least 200 meters away from the highway/main road? Yes No
27. Is your piggery located at least 200 meters away from other houses Yes No