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ASF EVOLUTION AND ITS ECONOMIC IMPACT IN EUROPE OVER THE PAST DECADE

Professor PhD **Adrian STANCU**
Petroleum-Gas University of Ploiești, Romania
astancu@upg-ploiesi.ro

Abstract:
African swine fever (ASF) is a virus that has widely spread in the last years. Even if ASF is a non-human transmission virus, it affects both domestic and wild pigs with significant negative impact on country's economy. Firstly, this paper emphasizes the main reasons for which the ASFV is deemed a very powerful virus and it presents the international and European organizations which fight against ASF. Considering the two major ways of transmission of ASF, namely sick animals and vectors, the evolution of the number and date of outbreak was analyzed for both domestic pigs and wild boars in Europe, between 2009 and 2018. The results showed that ASF virus transmission to domestic pigs was not made by the sick wild boar.

Key words: African swine fever, domestic pigs, wild boar, outbreak, Animal Disease Notification System

JEL classification: D18, L66, P46,

1. INTRODUCTION

African swine fever virus (ASFV) belongs to *Asfarviridae* Family, it is the only member of the genus *Asfivirus* and it represents the swine's hemorrhagic and endemic disease. It was discovered in Kenya by R. Eustace Montgomery during his research between 1910 and 1917. Initially, ASFV affected the sub-Saharan countries and it extended in Europe starting with 1957, when Portugal recorded the first outbreak (Plowright, 1986; Simulundu et al, 2017).

ASFV is a double-stranded DNA virus and it replicates in the reticuloendothelial system of the swine (Dixon et al, 2000; Atuhaire et al, 2013). ASF epidemiology is different among countries, regions and continents due to the type of hosts, environmental conditions, (Gallardo et al, 2015), the movement of fomites, etc.

According to the World Organization for Animal Health (OIE) there are two types of ASFV's hots (OIE, 2013):

- Animals such as African wild swine (warthogs), bush pigs, giant forest hogs in Africa and domestic pigs, European wild boar, and American wild pigs;
- Ticks of the genus *Ornithodoros*.

The transmission of ASFV is by (OIE, 2013):

- direct transmission due to the contact between sick and healthy animals mentioned above;
- indirect transmission through infected meat, soft ticks and fomites (e.g. clothes, vehicles, feed, etc.);
- tick vector.

The ASFV is a very powerful virus due to at least 8 reasons mentioned in table no. 1.

The international organizations which fight against ASF are the World Organization for Animal Health (OIE) and the Global African Swine Fever Research Alliance (GARA). The World Organization for Animal Health (former Office International des Épizooties) with the headquarters in Paris has 182-member countries (including Romania) and it is coordinated by the World Assembly of Delegates which unites the delegates of all 182-member states. OIE's main objectives are: (i) to inform about the animal diseases in the member countries based on their reports, (ii) to update its members with regard to the latest scientific methods used to test and eliminate the animal disease, (iii) to provide expertise for animal diseases, (iv) to develop health standards for animal

health which are recognized by the World Trade Organization, (v) to improve the veterinary infrastructure of developing and transition countries, and (vi) to ensure the animal welfare and food safety through its normative documents which are correlated with the Codex Alimentarius Commission's standards (OIE, 2018).

Global African Swine Fever Research Alliance (GARA) is an international organization which is presided by the 7 members of the Executive Committee. They are elected by the 33 worldwide institutions from veterinary domain (e.g. USDA ARS Foreign Animal Disease Research, Plum Island Laboratory, National Centre for Foreign Animal Disease, Faculdade de Medicina Veterinária, The Pirbright Institute, etc.) which are in fact their members. GARA collaborates with other 7 institutions on research projects. The GARA's main goal is to conduct and manage a global research in order to understand, prevent, identify, control and eradicate the ASF (GARA, 2018).

Table no. 1. The main reasons for which the ASFV is a very powerful virus

No.	Criterion	Description
1.	Transmission	It is made through both animals and vectors (ticks)
2.	The depth of the transmission	It is very high in the case of ticks because ASFV has a transstadial, transovarian, and sexual transmission
3.	Spread	The ASFV is a transboundary disease which easily spread from a country to another through fomites
4.	Activation	The virus has a wide pH activation scale which corresponds to most common human food, i.e. 3.6 – 11.5; The virus is active for a long period of time in blood (540 days for blood at 4°C and 105 days for putrefied blood), faces (11 days at room temperature), and tissues (1000 days for frozen meat, 300 days for dried meat, skin and fat, 182 days for salted meat, 110 days for chilled meat, 105 days for offal, 30 days for smoked and deboned meat, etc.) for uncooked pork and pork products
5.	Inactivation	The virus becomes inactive at 56°C for 70 minutes or 60°C for 20 minutes
6.	Source	The source is very wide starting with blood, tissues, and secretions and finishing with excretions of both sick and dead pigs
7.	Prophylaxis	Treatment and vaccination were not developed until now even if there is more than a century since it was reported in 1910 by R. E. Montgomery
8.	Impact	It has economic, social, psychological, and medical impact

Source: Made by author based on OIE, 2013; USDA, 2018; Plowright,1986; FAO, 2017; EFSA, 2010

In the European Union, food safety stands as a basic principle related to consumer rights (Ene, 2012; Ene and Matei, 2012). In this context, the European Food Safety Authority (EFSA) manages the animal health and welfare, and the ASF respectively. The Animal Disease Notification System (ADNS) has its roots in IDA (Interchange of Data between Administrations) programme which started in 1985 (Eur-Lex, 2005; IDABC, 2005).

The ADNS was operational after 2000, and it manages the outbreaks with respect to animal diseases in 46 countries which provide the necessary information. All UE member states and 12 non-EU member states (Norway, Iceland, Andorra, Faroe Islands, Turkey, Macedonia, Serbia, Montenegro, Switzerland, Albania, Bosnia and Herzegovina, and Kosovo) are part of ADNS (European Commission, 2015). In ADNS, the collecting of data and the exchange of information among countries and the European Union is made through a web platform (figure no. 1). Each national veterinary authority shares their animal disease outbreaks and keeps the others informed about their evolution (Animal Disease Notification System, 2018; Directorate-General for Health & Consumers, 2009).

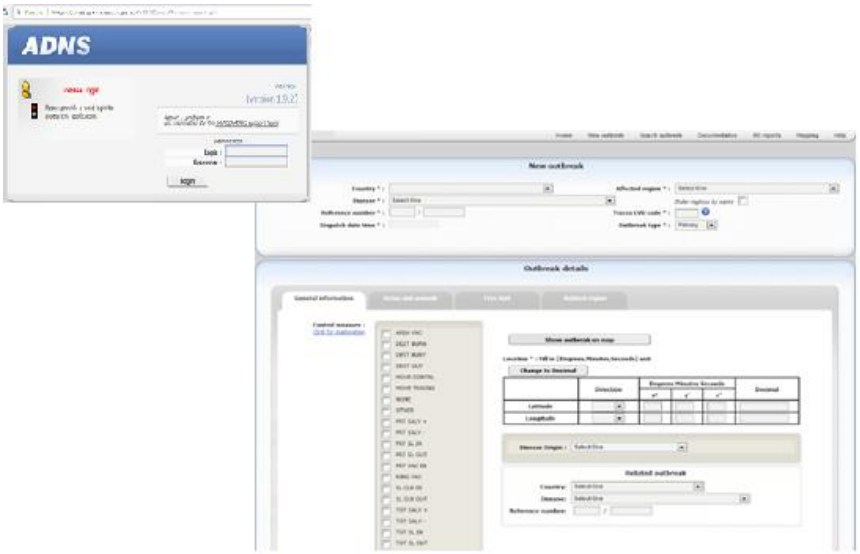

Figure no. 1. ADNS's interface of web platform

Source: Quintans, S. (2012), Notifications and exchange of information at national internal and EU level, Better Training for Safer Food BTSF, https://www.mapama.gob.es/es/ganaderia/temas/sanidad-animal-higiene-ganadera/emergentes10_tcm30-111758.pdf

2. EVOLUTION OF AFRICAN SWINE FEVER

As it was mentioned above, the ASF affects both the domestic pigs and the wild boars. In his chapter the number and date of outbreak are analyzed for both domestic pigs and wild boars in order to find out whether the ASF virus was transmitted to the domestic pigs by the sick wild boar or not.

2.1. EVOLUTION OF AFRICAN SWINE FEVER FOR DOMESTIC PIGS

Figure no. 2 shows the number of ASF outbreaks in the case of domestic pigs in Europe between 2009 and 2018. During these last 10 years, only 8 out of 46 countries reported outbreaks. For a better view, the 2009-2018 period was divided into four subperiods. Thus, between 2009 and 2011, Italy was the only country that reported ASF outbreaks with a peak in 2011, i.e. 31 outbreaks (figure no. 2a).

In the second subperiod (2012-2014), Italy remained the main country which notified outbreaks of ASF with a maximum value of 109 in 2013 (251% higher than the value in 2011). Starting with 2014 year, three more countries, Latvia, Lithuania and Poland reported outbreaks on their territories (figure no. 2b).

In 2015, Estonia reported the highest number of outbreaks (18) being followed by Italy (16 outbreaks), Lithuania (13 outbreaks), Latvia (10 outbreaks), and Poland (2 outbreaks). The next year brought important changes, i.e. Italy had the highest number of outbreaks (23) and at close range there were Poland (20) and Lithuania (19). It can be noticed that Latvia and Estonia reported fewer outbreaks in 2016 as compared to 2015, whereas Romania, Ukraine, and Bulgaria are still the countries with no outbreaks to be notified (figure 2c).

In 2017, Ukraine was the country which reported the highest number of outbreaks (124). Due to its border with Ukraine, Poland had the second number of outbreaks (81). In addition, Lithuania reported with 76.47% more outbreaks than Italy (figure 2d). In 2018, the number of outbreaks increases with 296.6% which is mainly due to Romania because it weighs 76.87% of the total number of outbreaks. Lithuania and Poland reported higher number of outbreaks as compared to 2017, with 63.33% and 29.62% respectively (figure 2d).

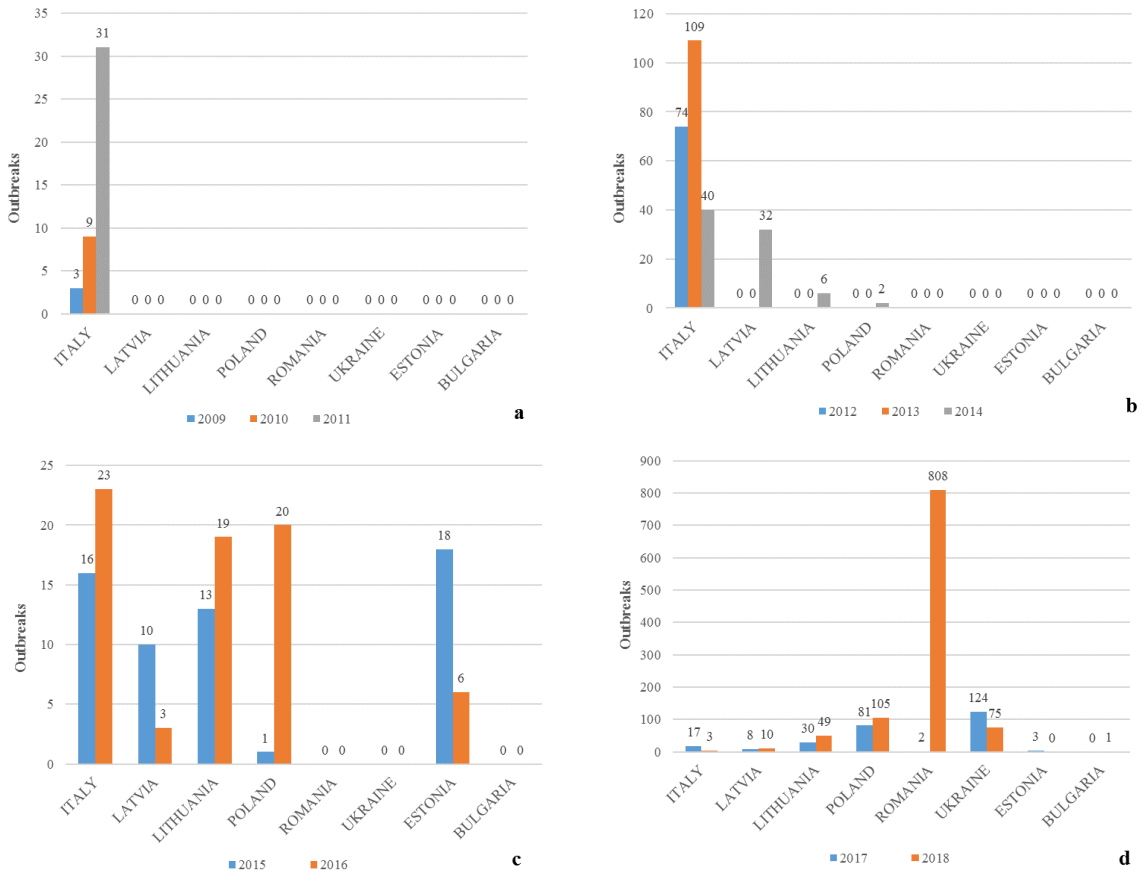

Figure no. 2. The number of ASF outbreaks for domestic pigs in Europe between 2009 and 2018*

Source: Made by author based on data in Animal Disease Notification System (ADNS) *Report Summary Animal Disease Notification System: Outbreaks per Disease 2009-2018*, **https://ec.europa.eu/food/animals/animal-diseases/not-system_en**

*Data is updated until 2nd September 2018 based on the Report published in 3rd September 2018.

There is a significant difference in the number of outbreaks among the 8 countries due to either the absence of ASFV in their territory or to problems in reporting to the European Commission. Overall, the number of outbreaks notified by the ADNS's member states had increased from 43 in 2009 up to 1051 at present. As figure no. 3 shows, the ASF moved from the Central and Northern Europe countries to Eastern European countries owing to the actions taken in Italy and Latvia to reduce the spread of ASF.

Another issue that must be analyzed is the date of the last outbreak. Figure no. 4 shows the month of the last outbreaks of ASF for domestic pigs in Europe between 2009 and 2018. Thus, in the case of Italy, the number of outbreak (figure no. 2a) is correlated with the month of the last outbreak (figure no. 4a) because the additional outbreaks identified in 2010 and 2011 caused the date of the last outbreak to change from May to July and December. Between 2012 and 2014, the month of the last outbreak was between August and December. August was the last outbreak for Poland and Lithuania in 2014, September was the last outbreak for Latvia, while December and October were the last outbreaks for Italy (figure no. 4b).

In 2015, Poland was the only country that recorded the last outbreak in the first semester (January) of the year. In the other countries, the last outbreak occurred in the second semester of the year, i.e. September (Estonia and Latvia), October (Lithuania) and November (Italy).

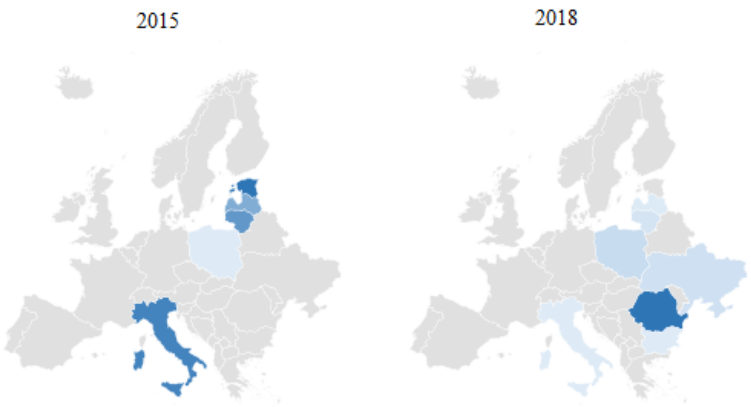

Figure no. 3. Progression of ASF outbreaks in Europe for domestic pigs in 2015 contrasted with 2018

Source: Made by author based on data in Animal Disease Notification System (ADNS) *Report Summary Animal Disease Notification System: Outbreaks per Disease 2015, 2018*, **https://ec.europa.eu/food/animals/animal-diseases/not-system_en**

In 2016, firstly, there were slight changes in case of Estonia where the last outbreak was one month sooner than in the previous year, and for Lithuania where the last outbreak was one month later than during the previous year. Secondly, in Poland, the last outbreak occurred in September, while Latvia and Italy reported the same month as in the previous year (figure no. 4c).

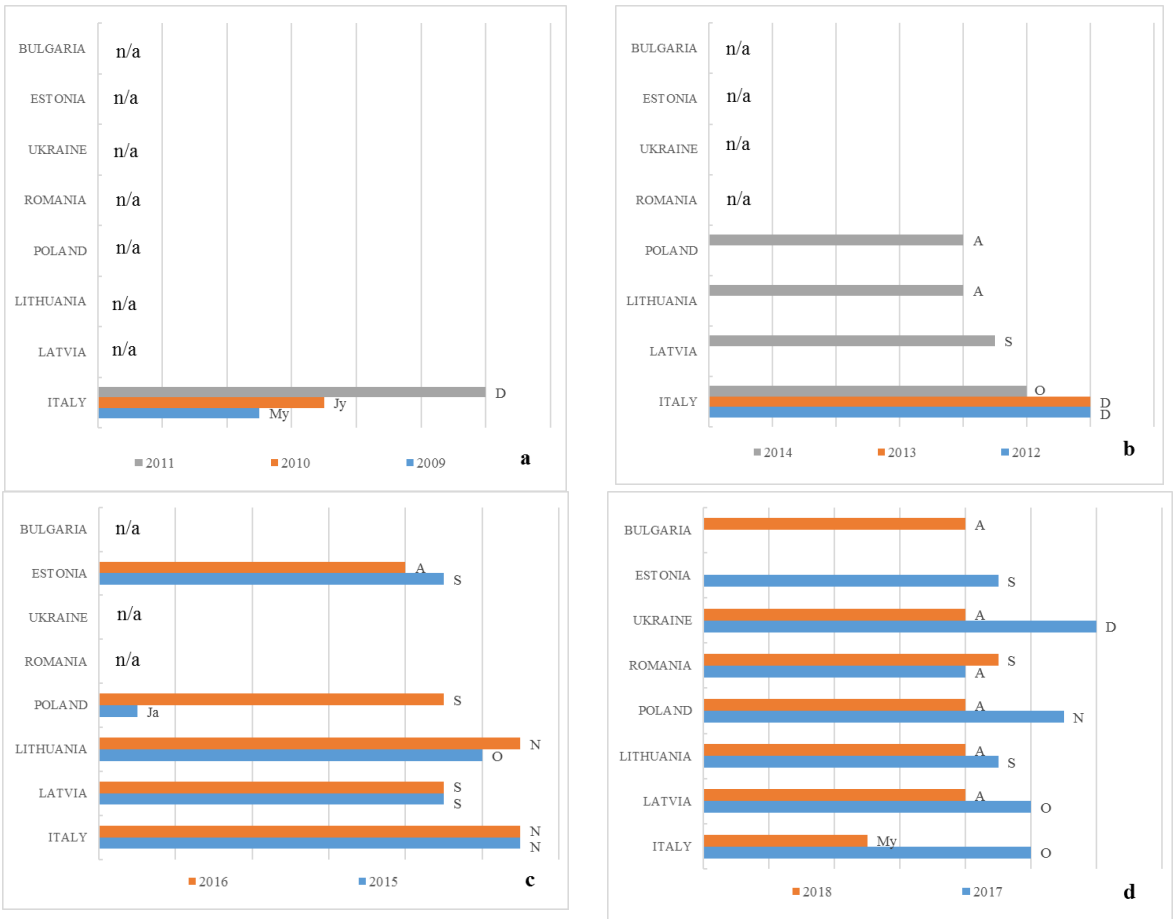

Figure no. 4. The month of last ASF outbreaks for domestic pigs in Europe between 2009 and 2018*

Source: Made by author based on data in Animal Disease Notification System (ADNS) *Report Summary Animal Disease Notification System: Outbreaks per Disease 2009-2018*, **https://ec.europa.eu/food/animals/animal-diseases/not-system_en**

*Data is updated until September 2nd, 2018 based on the Report published in September 3rd, 2018.

Ja – January, My – May, Jy – July, A – August, S – September, O – October, N – November, D – December.

In 2017, in Estonia and Lithuania the last outbreak was in September, which Latvia and Italy reported in October, Poland in November, and Ukraine in December (figure no. 4d). The date of outbreaks in 2018 cannot be analyzed objectively because the last available report comprises data until September 2nd. However, 5 out of 7 countries recorded the last outbreak in August. In Italy the last outbreak occurred in May, while in Romania the last outbreak registered in September.

2.2. EVOLUTION OF AFRICAN SWINE FEVER FOR WILD BOAR

Figure no. 5 is illustrative of the ASF outbreaks among wild boar in Europe between 2009 and 2018. The analysis is made by following the same procedure described in the previous sub-chapter. Between 2009 and 2011, Italy was the only country that recorded ASF outbreaks in the wild boar. The highest number of outbreaks was in 2011 (figure no. 5a).

In the following 2 years, Italy continued to be the only country which reported ASF outbreaks, but the number of outbreaks increased over 5 times in 2012 and over 22 times in 2013 as compared to 2011. Taking into account the number of countries and the number of outbreaks, 2014 represents a milestone for both criteria. Thus, 4 new countries (Estonia, Latvia, Lithuania, and Poland) recorded ASF outbreaks in the wild boar and Latvia's number of outbreaks was with 393.3% higher than in Poland, with 260.9% higher than in Estonia, 228.8% higher than in Lithuania, and 111.42% higher than in Italy (figure no. 5b).

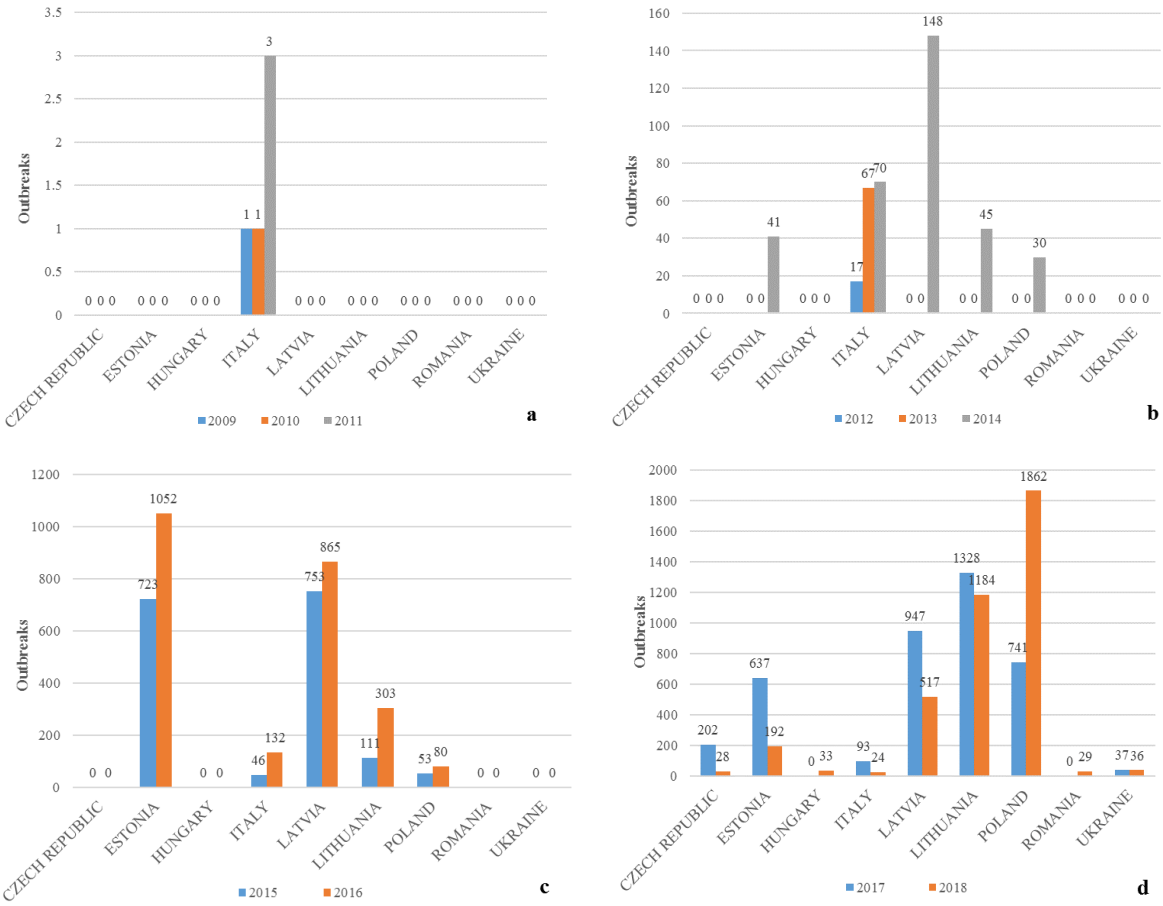

Figure no. 5. The number of ASF outbreaks for wild boar in Europe between 2009 and 2018*

Source: Made by author based on data in Animal Disease Notification System (ADNS) *Report Summary Animal Disease Notification System: Outbreaks per Disease 2009-2018,* **https://ec.europa.eu/food/animals/animal-diseases/not-system_en**

*Data is updated until 2nd September 2018, based on the Report published in 3rd September 2018.

In 2015 the number of outbreaks increased dramatically as compared to 2014 for 4 out of 5 countries that recorded outbreaks. The rate of increase in outbreaks was 17.6 times in Estonia, it expanded by a factor of 5 in Latvia, becoming 2.4 times larger in Lithuania, while in Poland it increased 1.7 times. Italy was the only state in which the number of outbreaks decreased by 0.65 times. The year 2016 brought out a new wave of augmented outbreaks for all states. Thus, the number of outbreaks escalated by 186.9% in Italy, 172.9% in Lithuania, 50.9% in Poland, 45.5% in Estonia, and by 14.8% in Latvia (figure no. 5c).

Starting with 2017, two new countries started to report ASF outbreaks in wild boar, i.e. Czech Republic (202 outbreaks) and Ukraine (37 outbreaks). In the case of Estonia and Italy, the number of outbreaks decreased by 39.4% and 29.5% respectively as compared to 2016. Instead, Latvia, Lithuania, and Poland recorded higher numbers of outbreaks: 9.4%, 338.2% and 826.2%. Even if the available data for 2018 ends by September 2nd, it can be noticed that Hungary and Romania recorded their first outbreaks of ASF in wild boar, whereas Poland already faces 251 times more outbreaks as compared to the previous year (figure no. 5d).

As regards the date of the last outbreak, figure no. 6 shows the month of the last ASF outbreaks in wild boar in Europe between 2009 and 2018. During the first sub-period, the month of the last outbreak in Italy fluctuated significantly, starting with November in 2009, continuing with April in 2010, and ending with December in 2011 (figure no. 6a).

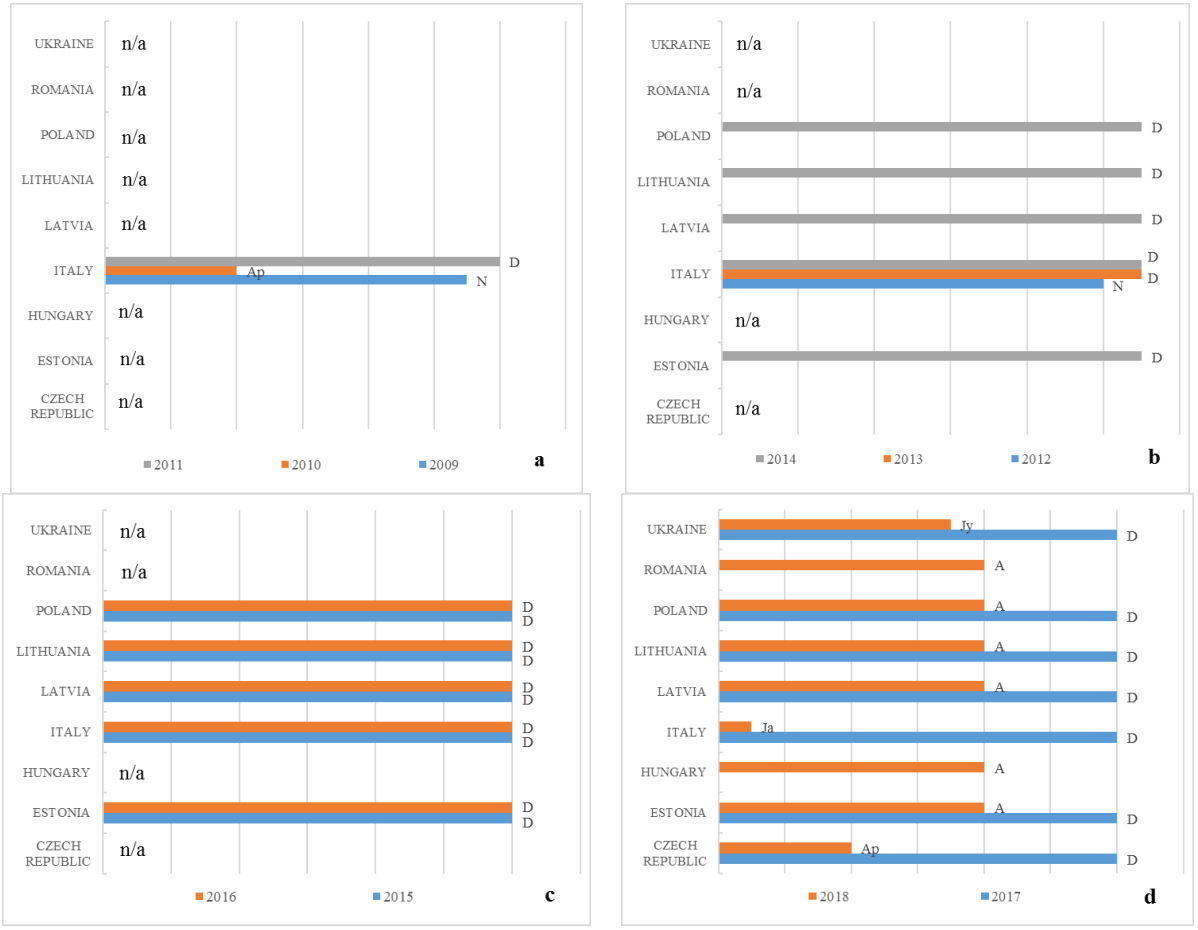

Figure no. 6. The month of last outbreaks of ASF for wild boar in Europe between 2009 and 2018*

Source: Made by author based on data in Animal Disease Notification System (ADNS) *Report Summary Animal Disease Notification System: Outbreaks per Disease 2009-2018*, **https://ec.europa.eu/food/animals/animal-diseases/not-system_en**

*Data is updated until September 2nd, 2018 based on the Report published in September 3rd, 2018.
Ja – January, Ap – April, Jy – July, A – August, N – November, D – December.

Between 2012 and 2014, there were no major differences because in 2014 all five reporting countries (Poland, Lithuania, Latvia, Italy, and Estonia) had December as the month of the last outbreak. Only in 2012, Italy recorded its last outbreak in November (figure no. 6b). In the third sub-period, December was the month of the last outbreak for all these five countries (figure no. 6c).

In 2017, December was again the month of the last outbreak in all seven reporting countries (Ukraine, Poland, Lithuania, Latvia, Italy, Estonia, and Czech Republic). In 2018, it can be noticed that Ukraine, Italy, as well as the Czech Republic have recorded outbreaks in July, January, and April (figure no. 6d). For the other countries the month cannot be interpreted because it depends on the published date of the ADNS's last report which was September 3rd.

3. ECONOMIC IMPACT OF ASF

As it was shown in table no. 1, ASF has economic, social, psychological, and medical impact. In the case of economic impact, the livestock industry, agriculture, food industry, trade, and tourism are most vulnerable.

Firstly, ASF has negative impact on livestock industry because all infected animals must be slaughtered, and the mortality rate is approximately of 100% in the acute form of the disease (OIE, 2013). There is total loss for both individual breeders and stock farms. For example, in Romania, ASF recorded in 2018 lead to the slaughtering of 348,691 domestic pigs out of 4,129,293 which is the total number of domestic pigs (ANSVSA, 2018; INS, 2018). Thus, during approximately 9 months, the number of domestic pigs decreased dramatically with 8.44% due to the ASF.

Secondly, the agriculture is negatively affected through the decline of feed demand as a result of the decrease of domestic pigs and fact that feed is an indirect transmission vector of ASF form infected to healthy pigs.

Thirdly, the companies from the food industry have to find new suppliers for pork meat if the consumers' demand for pork products remains unchanged. Sometimes the suppliers are form foreign countries and the price of pork meat is high which involves a higher price of pork products for consumers. In the case of decreasing of consumers' demand for pork products, the companies' sales will fall, and they have to focus on other type of meat according to the consumption patterns on the market.

Fourthly, the export of pork meat and pork products decreases because any importing country wants to avoid introducing ASF in their food chain. The importing companies are dealing with the clients' psychological pressure knowing that the meat or meat products might have been contaminated with ASF. Also, the import of pork meat and pork products increases for countries that recorded ASF to satisfy the domestic demand.

Fifthly, the rural tourism and ecotourism are negatively affected in the areas where ASF is recorded because the companies that are focus on these forms of tourism offer local foods and drinks prepared according to the traditional recipes based on local raw products (vegetables, fruits, eggs, meat, etc.). Thus, the pork meat consumers will no longer be interested in traveling in these areas.

4. CONCLUSIONS

Italy was the country that reported ASF outbreaks in domestic pigs starting with 2009 which was the first year of the period that was analyzed and remained the only country that recorded ASF for 5 consecutive years. Similarly, Latvia, Lithuania, and Poland reported continuous ASF outbreaks in domestic pigs but for a shorter period, only between 2014 and 2018. On the opposite, Romania and Bulgaria reported each only in one year.

In the case of ASF in wild boar, Italy was again the only country that faced outbreaks starting with 2009 until present, while Latvia, Lithuania, and Poland recorded constant outbreaks between 2014 and 2018. Instead Romania reported the outbreaks only in 2018.

Throughout these past 10 years, there have been 7 countries that faced outbreaks in both domestic pigs and wild boar, namely Italy, Latvia, Lithuania, Poland, Romania, Ukraine, and Estonia, two countries which dealt with outbreaks only in wild boar (Czech Republic and Hungary), and one country that tackled outbreaks only in domestic pigs.

There are significant differences concerning the date of the last outbreak. August, September, October and sometimes November are the months of last outbreak in domestic pigs, whereas December was in most of the cases the month of the last outbreak in wild boar. This data supports the idea that for most countries the transmission of the ASFV to domestic pigs was not made by the sick wild boar.

The economic impact of ASFV is not insignificant taking into account that it influences at least five of the branches of economics. Also, the ASFV has a major social, psychological, and medical effect on humans.

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