Food and Agriculture Organization
of the United Nations

GLOBAL ANIMAL DISEASE INTELLIGENCE REPORT

JANUARY – DECEMBER 2015

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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Summary

Animal disease situation

The year 2015 was characterized by the continued spread or incursion of different foot-and-mouth disease (FMD) serotypes. FMD serotype O (known as O/ME-SA/Ind-2001) and SAT 2 continued to spread in North Africa and southern Africa, while a serotype O incursion was reported in Mongolia. A serotype O similar to the Mongolian virus continued to spread in the Republic of Korea during the first half of 2015. A new serotype A lineage (known as A/ASIA/G-VII [G-18]) originating from the Indian subcontinent has emerged in several countries in the Middle East.

Vector-borne diseases such as lumpy skin disease (LSD) and Rift Valley fever (RVF) were also observed and likely to be associated to the El Niño event and climate anomalies observed in some regions. LSD was introduced into Greece and the Russian Federation, while new outbreaks were recorded in Turkey. RVF was reported in Mauritania between September and October in humans and small ruminants.

Overall, the reporting year was characterized by continued, albeit lower-level, circulation of avian influenza (AI) in previously affected countries in Africa, Asia and the Middle East. There were no reports from the Americas on highly pathogenic avian influenza (HPAI-H5N1) outbreaks while there were new incursions of different low and highly pathogenic avian influenza viruses into European countries.

A high diversity of non-H5N1 influenza virus subtypes associated with disease outbreaks in poultry and wild birds was reported in Asia and the Americas during the reporting period. In West Africa, the Ebola virus continued to circulate in humans at very low levels in Guinea and Liberia; the number of weekly cases having been reduced to less than five in each country. Liberia has had two re-emergence events during this period.

In the Near East, Jordan, Kuwait and Saudi Arabia continued to identify human cases of Middle East respiratory syndrome Coronavirus (MERS-CoV). In Southeast Asia, the first cases imported into the Republic of Korea and Thailand were reported from April to June 2015. Following the introduction and spread of MERS-CoV in the Republic of Korea, a few cases were reported in early July. No new cases have been reported since.

Risk assessment

LSD

The main possible pathways for LSD introduction from the affected regions of Greece into free areas are considered to be the movement of infected animals and vectors. Spread of LSD in Greece has been mainly mitigated by the vaccination of susceptible animals and movement restrictions in the affected areas. The current disease situation in other countries is difficult to assess since there are not enough data available to determine the impact of the implementation of mitigation strategies.

RVF

In West Africa: Given that during the dry season climatic and environmental conditions are unsuitable for RVF vectors in this region, the risk of RVF emergence and transmission is considered low until the beginning of the wet season 2016.

SECTION 1

Overview of the animal disease situation

Livestock disease events

Foot-and-mouth disease (FMD)

FMD is endemic in many countries in **Africa** and **Asia**, and in 2015, several FMD serotypes were observed either for the first time or as part of continuing outbreaks across various subregions (see Figure 1). FMD serotype O (known as O/ME-SA/Ind-2001) and SAT 2 continued to spread in **North Africa** and southern Africa, while a serotype O incursion was observed in Mongolia. A serotype O similar to the Mongolian virus continued to spread in the Republic of Korea during the first half of the 2015. A new serotype A lineage (known as A/ASIA/G-VII [G-18]) which originated from the Indian subcontinent has emerged in several countries in the Middle East.

The serotype O lineage (called O/ME-SA/Ind-2001) spread from the initially infected areas of **North Africa** (Tunisia and Algeria) to Morocco in November 2015 via unknown routes. The first incursion of the virus into Morocco was officially confirmed in a mixed farm (cattle and sheep) located in the Sidi Bennour Province (Central region), approximately 800 kilometres from the Algerian border. The outbreak occurred in late October 2015 and the virus isolated shared 99.2 percent and 98.90 percent of homology with an FMD strain isolated in Tunisia and Algeria in 2014, respectively. During the initial outbreak, FMD was confirmed in 10 unvaccinated cattle out of the 17 susceptible cattle and 14 sheep present on the farm. Five additional outbreaks were subsequently detected mostly in mixed production farms in the same region. This was the first FMD incursion into Morocco since 1999. In this country, a preventive mass-vaccination campaign targeting cattle started in 2014. The first round was conducted in August to November 2014, the second and third rounds in February to May, and November to December 2015, respectively. Since the incursion, the national authorities have increased vaccination efforts by implementing peri-focal vaccination targeting small ruminants, around outbreaks. The vaccine used includes both O Manisa and O 3039 strains. As a result of this FMD virus incursion, in 2014 and 2015, Algeria conducted an emergency vaccination campaign targeting the 1.6 million cattle present in the country; in 2015, this was coupled with vaccination targeting small ruminants around the detected outbreaks.

The disease continued to spread in Algeria during 2015, moving from the mostly affected northern part of the country to the northeast between March and April. Since the initial reports in July 2014, Algeria has confirmed at least 432 outbreaks in 31 out of 48 (64.6 percent) provinces in different livestock species (cattle, sheep and goats).

The strain O/ME-SA/Ind-2001 currently affecting countries in North Africa is the dominant FMDV lineage present in the Indian subcontinent. This lineage was detected in Libya from December 2011 and in Bahrain, Saudi Arabia and the United Arab Emirates between 2013 and 2015. More recently, it was found in Tunisia (April 2014), in Algeria (July 2014) and in Morocco (November 2015).

In **southern Africa**, several countries reported FMD (mostly serotype SAT2) outbreaks during 2015: Angola, Botswana, Malawi, Mozambique, Namibia, Zambia and Zimbabwe.

Abnormally dry conditions during the year in areas across Angola, Botswana, Namibia and Zimbabwe have caused increased movement of animals in search of water. In northern Namibia, farmers moved their cattle into Angola for water and grazing. In Zimbabwe, the dryness caused increased movement of cattle close to national parks where they share grazing and watering points with wild buffalo.

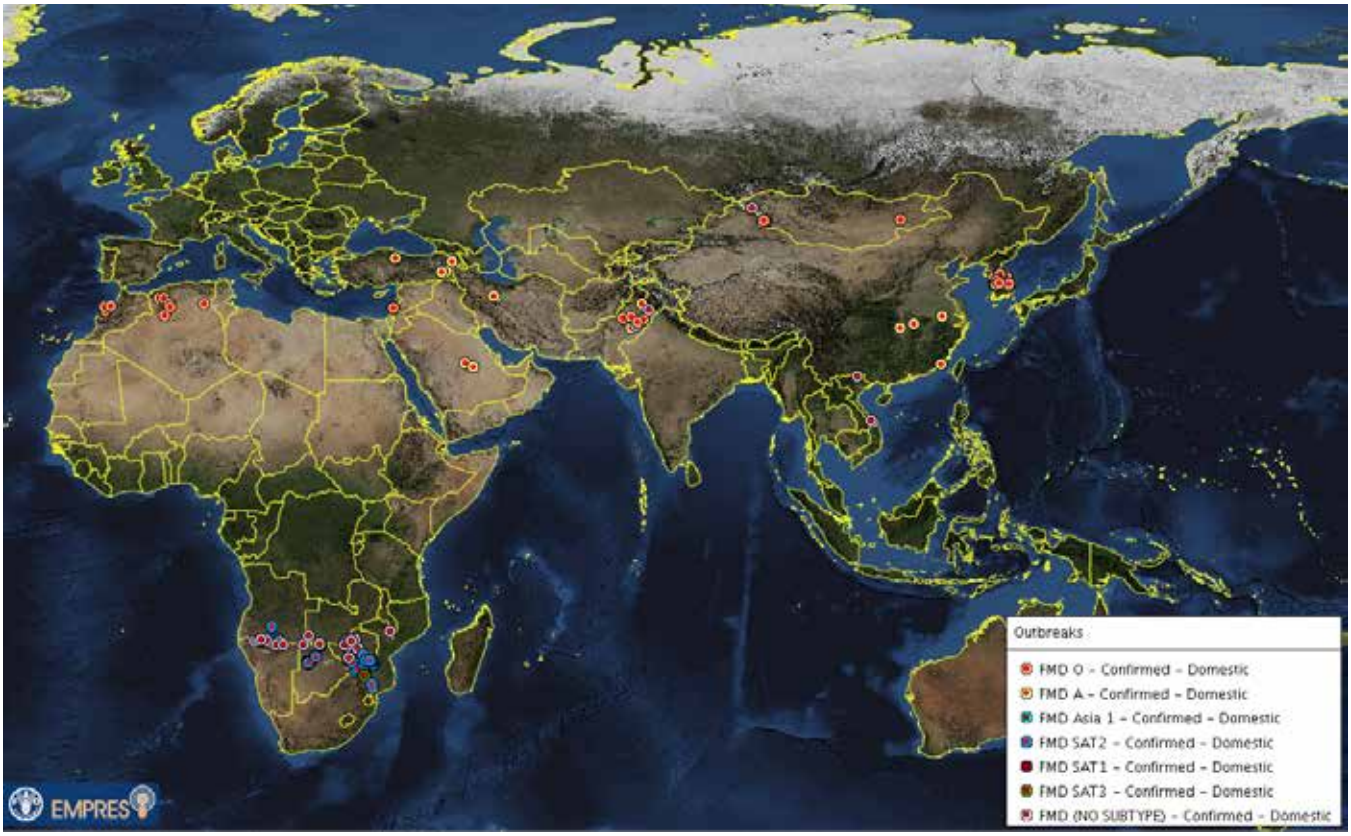
A new serotype A lineage (named A/ASIA/G-VII [G-18]) emerged in 2015 from the Indian subcontinent and has spread to three countries in the Middle East and Central Asia (the Islamic Republic of Iran, Saudi Arabia and Turkey). First isolated during an outbreak in the Ghon region of the Islamic Republic of Iran at the end of August 2015, the virus was subsequently detected in Saudi Arabia and Turkey in September and October, and in Armenia in December. The outbreak in Armenia occurred in late December on a mixed farm (cattle and pigs) in Armavir province near the border with Turkey. Vaccine-matching data indicate that field isolates are not well matched against any of the vaccines that are currently used in the region. In response, Turkey has started vaccinating cattle with newly produced vaccines that include the new virus strain; vaccine-matching studies are ongoing. Saudi Arabia has vaccinated cattle and sheep with a vaccine, normally used only for cattle, which includes A Saudi Arabia-95 for which vaccine matching conducted at the Pirbright Institute in the Unit-

ed Kingdom of Great Britain and Northern Ireland showed some effectiveness.

Outbreaks due to serotype O were detected in Israel and The West Bank during 2015.The outbreaks in Israel occurred in pig and beef cattle in or near the Fassuta district while the outbreak in The West Bank occurred in a sheep flock in the Nablus district. In Israel, an annual vaccination campaign is ongoing; cattle are vaccinated with a trivalent O/A/Asia1 vaccine while small ruminants (sheep and goats) are vaccinated with a bivalent O/A vaccine.

In **Asia,** the **Republic of Korea** continued to report FMD outbreaks, after initial confirmation in July 2014. Between January and June 2015, 159 outbreaks of serotype O were reported across several cities/counties in six provinces, with 87 percent of outbreaks occurring in pig farms. After gaining the World Organisation for Animal Health (OIE) recognition as an "FMD free country where vaccination is practised" in May 2014 (last reported outbreak occurred in November 2011), the **Republic of Korea** lost this status due to a new outbreak of the same serotype in Uiseong county in July 2014. FMD viruses (within the O/SEA/Mya-98 lineage) have been responsible for field outbreaks in the Republic of Korea since 2010. This is supported by sequence data that confirm frequent introductions of the O/SEA/Mya-98 lineage into the country. This serotype has caused at least five outbreaks in cattle and sheep farms in two regions of Mongolia between February and May of 2014. These episodes provide an indication of the burden (infectious pressure) that exists due to ongoing FMD outbreaks in neighbouring endemic countries in the East and Southeast Asia regions (European Commission for the Control of Foot-and-Mouth Disease (EuFMD) surveillance report, January 2016).

Figure 1. Point locations of FMD outbreaks during 2015 (by serotype)



Lumpy skin disease (LSD)

In 2015, LSD was reported in Europe (Cyprus, Greece and the Russian Federation) and Asia (Armenia, Kuwait, Saudi Arabia and Turkey) (see Figure 2). The disease is endemic in a region of Greece and in Iraq, Oman and Turkey.

As of 31 December 2015, Greece reported a total of 116 outbreaks of LSD. The disease initially appeared in the Evros region on the border with Turkey, and from there moved into North Evros and South Evros, Xanthis, Rodopi, Kavala, Limnos Chalkidiki and Thessaloniki affecting three regions (i.e. eastern Macedonia and Thrace region, central Macedonia and north Aegean).

At the time the disease was first reported (August, 2015), Greece implemented several control measures including depopulation of clinically affected animals (stamping out), implementation of a surveillance area, and movement controls on exit from the entire Evros Prefecture (controls included bans on the movements of (1) live bovine and wild ruminants, (2) bovine semen, (3) fresh meat produced from bovine animals, and meat preparations and meat products produced from such fresh meat, (4) milk and dairy products from bovine animals and (5) unprocessed animal products and by-products of bovine animals.

By September 2015, Greece implemented a compulsory vaccination using a homologous live attenuated vaccine (Neethling strain), targeting all cattle and buffalo in the regional unit defined by the European Union as a restricted area, with a requirement of a 28-day standstill for vaccinated animals. Other mitigation measures included prohibitions of movement of vaccinated animals (which species) into other European Union states, bovines younger than six months of age, and unvaccinated animals born from dams vaccinated against LSD. In addition, some specific restrictions apply also to the movement of susceptible animals, fresh meat and other related commodities within the country and the affected region.

Since September 2015, the disease has spread to regional units located approximately 90 kilometres from the original detection (regional units of Kavala and Xanthi). By the end of 2015, the number of reported outbreaks decreased most likely reflecting the effect of the mitigations. Figure 3 shows the epidemic curve of the 2015 LSD outbreaks.

Figure 2. LSD outbreaks in Asia and Europe (2014–2015)

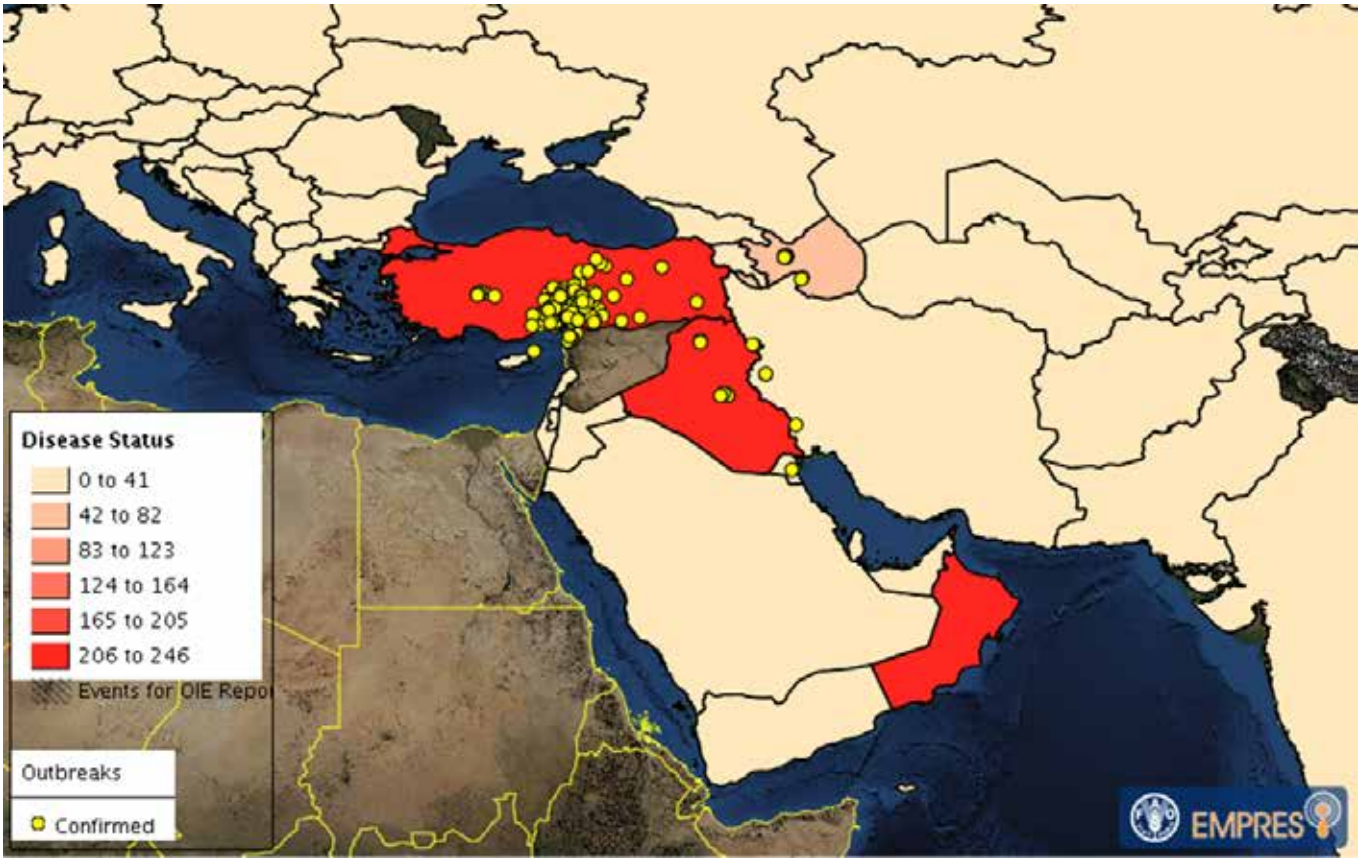
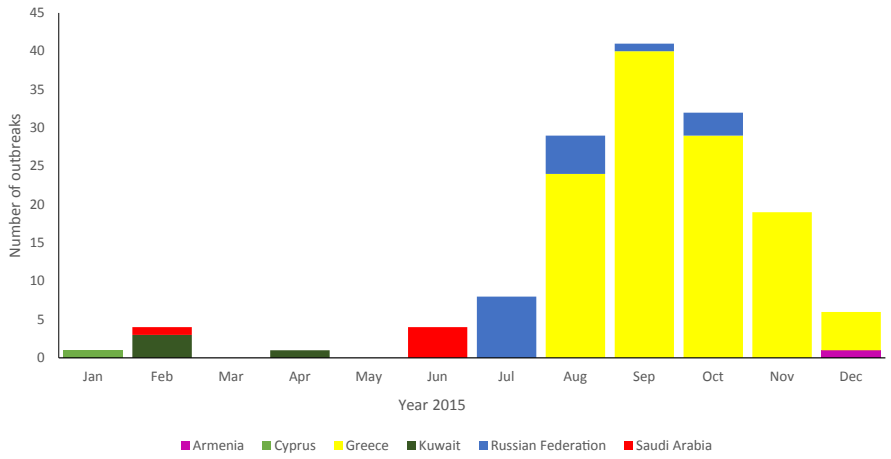


Figure 3. Number of LSD reported cases during 2015



Rift Valley fever (RVF)

Mauritania reported RVF in both livestock and humans between September and October 2015. The outbreaks occurred in southern Mauritania (Aleg, Maghta Lahjar, Moudjera and Kiffa provinces) affecting domestic livestock (19 confirmed cases) and humans (25 cases, including 8 deaths) coinciding with an above-normal rainy season.

Unlike previous events, this RVF episode was not characterized by a massive wave of abortions in animals, human exposure and human cases. All animals confirmed infected with the RVF virus were destroyed. In Mauritania, RVF susceptible species are not vaccinated. Five large outbreaks of RVF occurred in Mauritania in 1998, 2003, 2010, 2012 and 2013.

Despite the suitable climatic and environmental conditions driven by El Niño in East Africa, no human and animal cases – either suspected or confirmed – were detected and reported in this region during the year 2015. The last RVF outbreak in East Africa started in Kenya in December 2006, following a period of heavier than usual rainfall and widespread flooding. The disease subsequently spread to Somalia, the United Republic of Tanzania and the Sudan in 2007.

Endemic animal diseases

During 2015, endemic animal diseases such as anthrax, Newcastle disease (ND) and peste des petits ruminants (PPR) continued to be reported across the globe. See Figures 4, 5a, 5b and 5c.

Anthrax

During the period 2014 to 2015, 74 countries on five continents (Africa, Asia, the Americas, Europe and Oceania) reported cases of anthrax to the OIE (see Figure 4). Most reports came from Africa (26 affected countries), followed by Asia (20), the Americas (12), Europe (14) and Oceania (2). The country with the highest number of reports in 2015 was Argentina. In Europe, the disease was reported in Italy, the Balcanian peninsula and the United Kingdom of Great Britain and Northern Ireland.

Examination of the distribution of disease reports during the past five years (from 2011 to 2015, see Figure 5a) confirms that most reports came from anthrax-endemic areas including eastern and western Africa, central and southern America, western and south-east Asia. In the affected countries of southern and eastern Europe, the presence of the disease was limited to a few areas. In some areas of the globe, the occurrence of anthrax is endemic and is a seasonal disease of livestock, showing diverse patterns and depending on risk factors related to: climate, soil conditions and trade, amongst others. Most of the outbreaks occurred before August and affected multiple animal species. On the African continent, the disease was reported in wild animals, including those living in protected areas (e.g. elephants and rhinos).

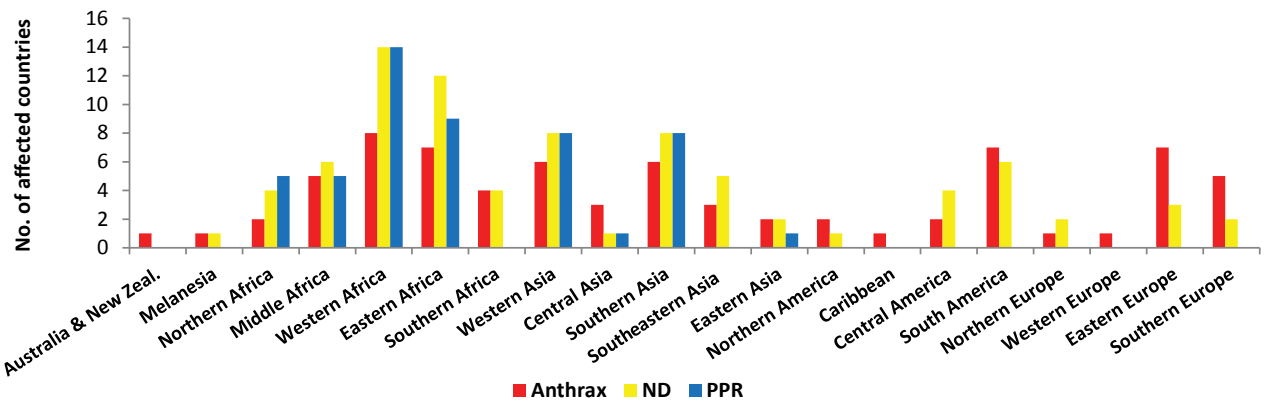
Newcastle disease (ND)

In 2014 and 2015, ND was reported in poultry by 83 countries across four continents (Africa, America, Asia and Europe) (see Figure 4). Most reports came from Israel, followed by Botswana, China and Romania. From 2011 to 2015 (see Figure 5b), 112 countries reported at least one outbreak of the disease. Most affected areas were: western, middle and eastern Africa, Central and South America, South and Southeast Asia. In eastern and southern Europe and northern Africa the presence of the disease was limited to a few areas. The presence of the virus in many countries is generally under-reported, mainly because of the large presence of smallholder rural poultry farms, limited contact and communication with the veterinary services, and the inability of farmers to differentiate the disease from other infections such as AI.

Peste des petits ruminants (PPR)

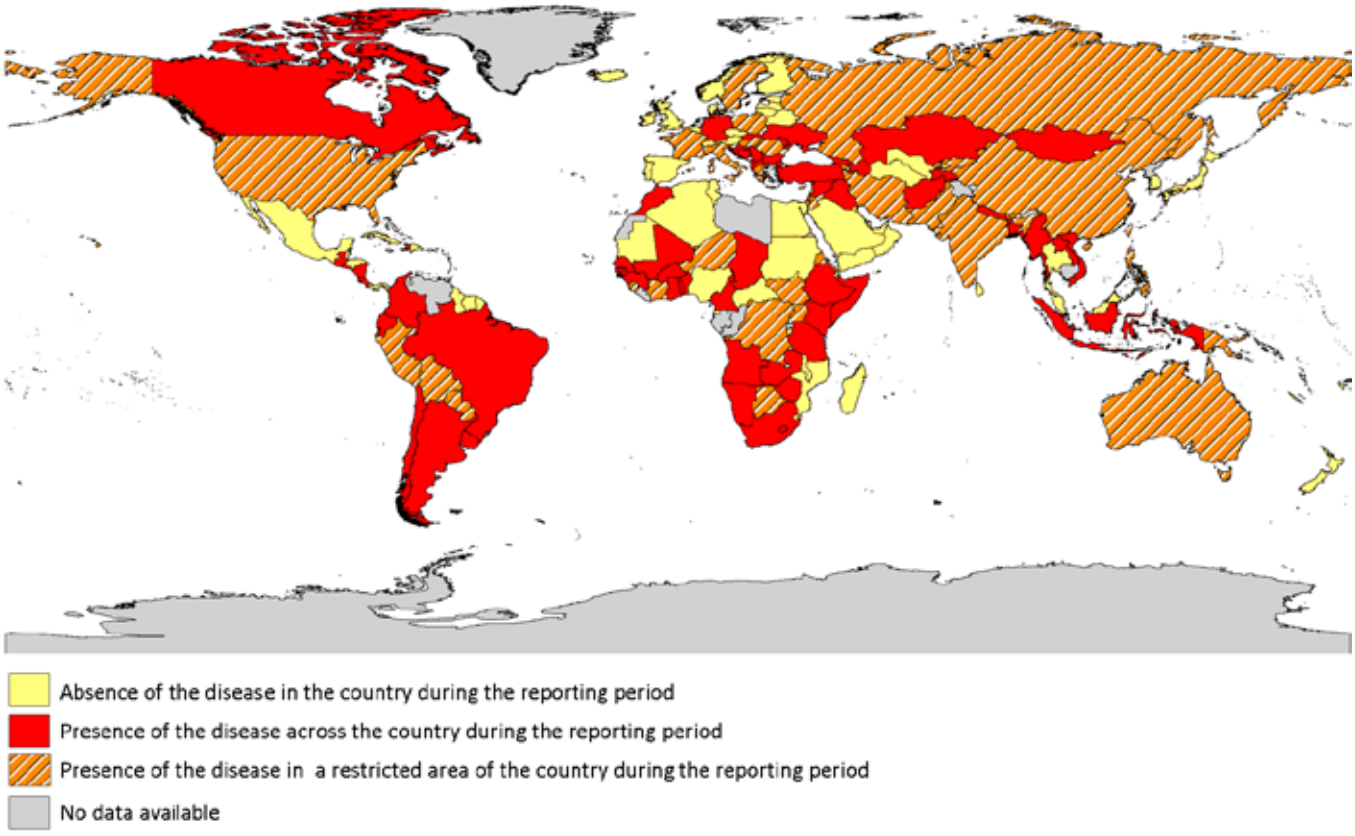
From 2014 to 2015, PPR was reported by 51 countries: in Africa (33 countries) and Asia (18 countries), mostly from areas where the disease is considered endemic. Affected regions included western, middle and eastern Africa and western and southern Asia (see Figure 5c). In 2015, PPR reports were restricted to defined zones in Bhutan, China, the Democratic Republic of the Congo, India, Israel, the Niger and the Sudan, while Liberia reported the first occurrence of PPR in April 2015. Kuwait reported the largest number of outbreaks (163) for the year.

Figure 4. Number of countries by subregion reporting outbreaks to the OIE between January 2014 and December 2015 for the three endemic diseases (anthrax, ND and PPR)



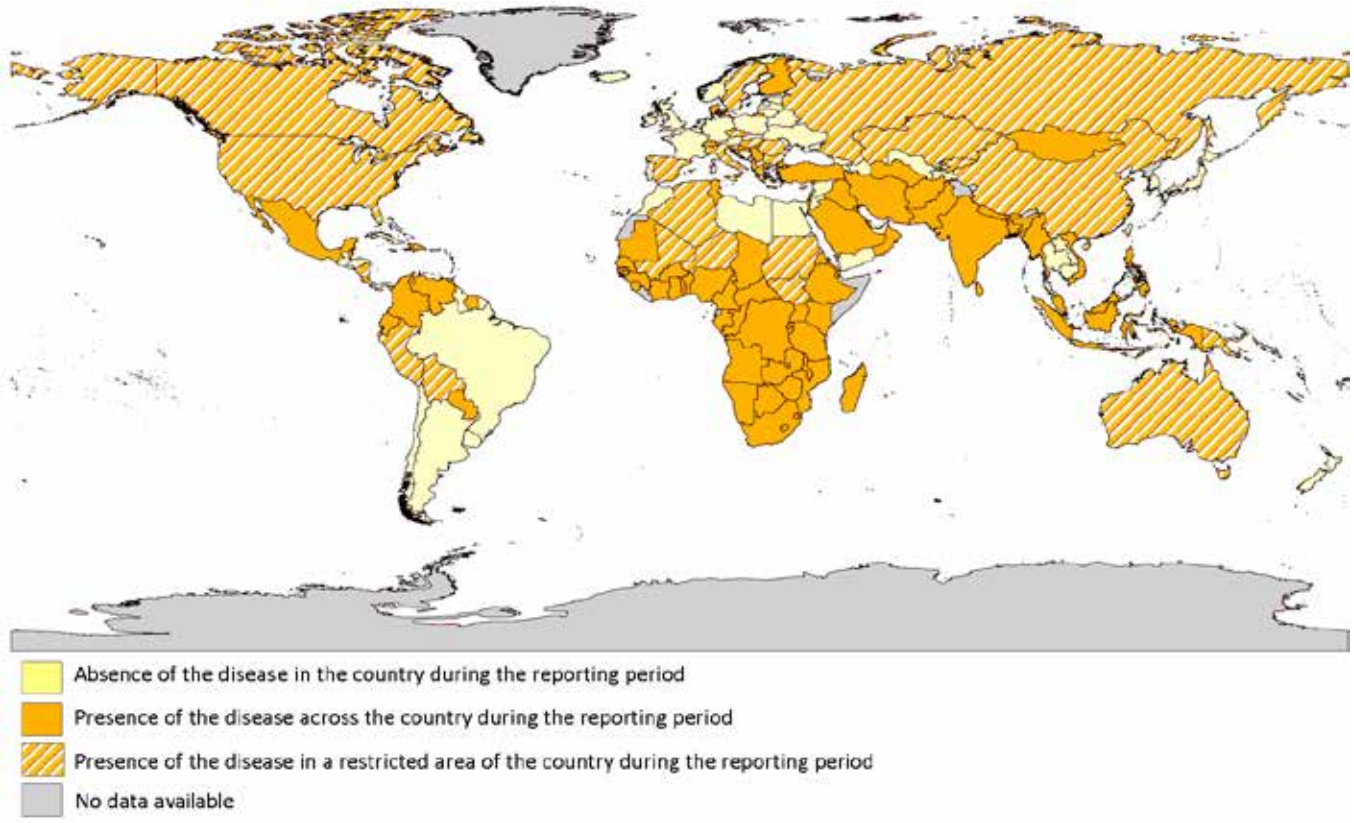
Source: OIE, 2016

Figure 5a. Global distribution of anthrax incidence by country in last five years (2011–2015)



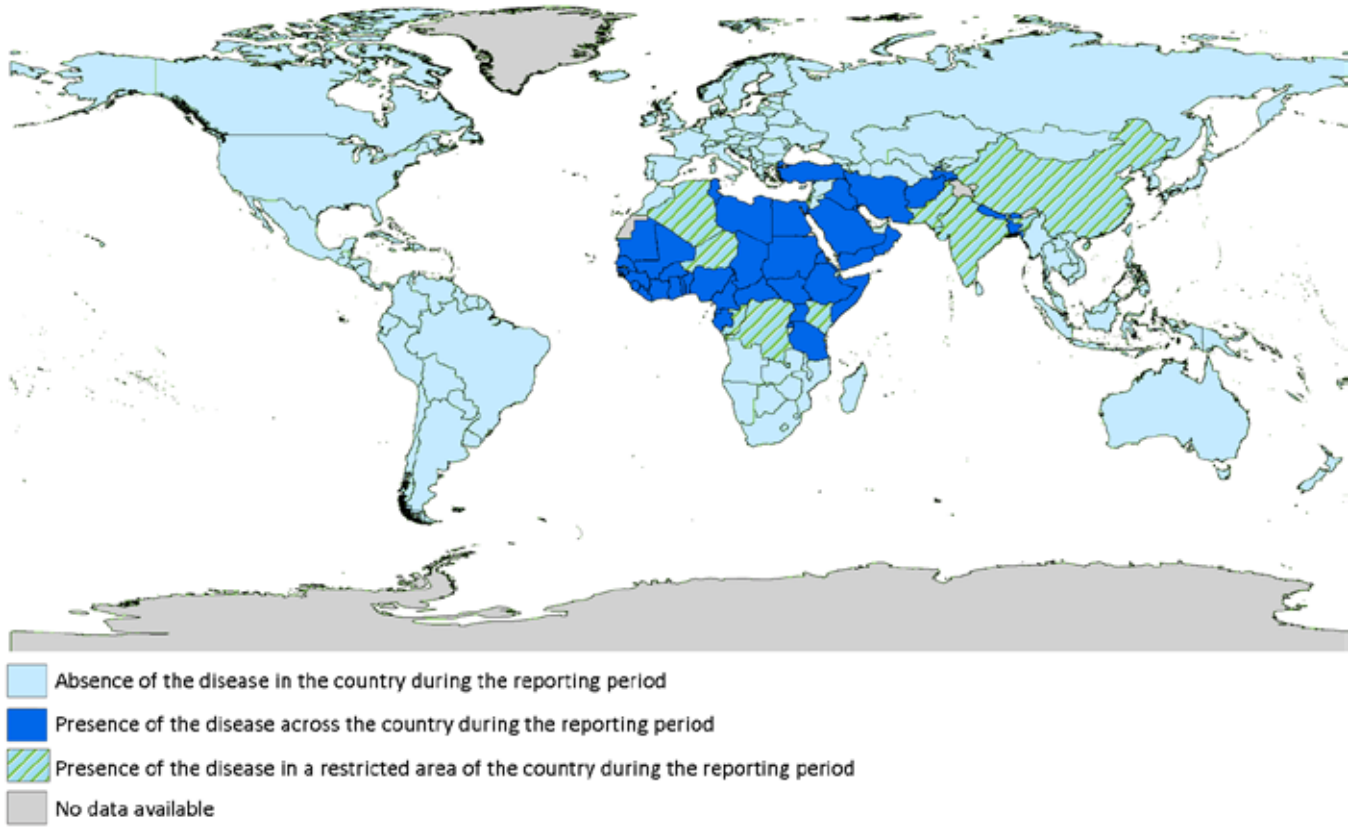
Source: OIE, 2016

Figure 5b. Global distribution of ND reports by country in last five years (2011–2015)



Source: OIE, 2016

Figure 5c. Global distribution of PPR incidence by country in last five years (2011–2015)



Source: OIE, 2016

Zoonotic disease events

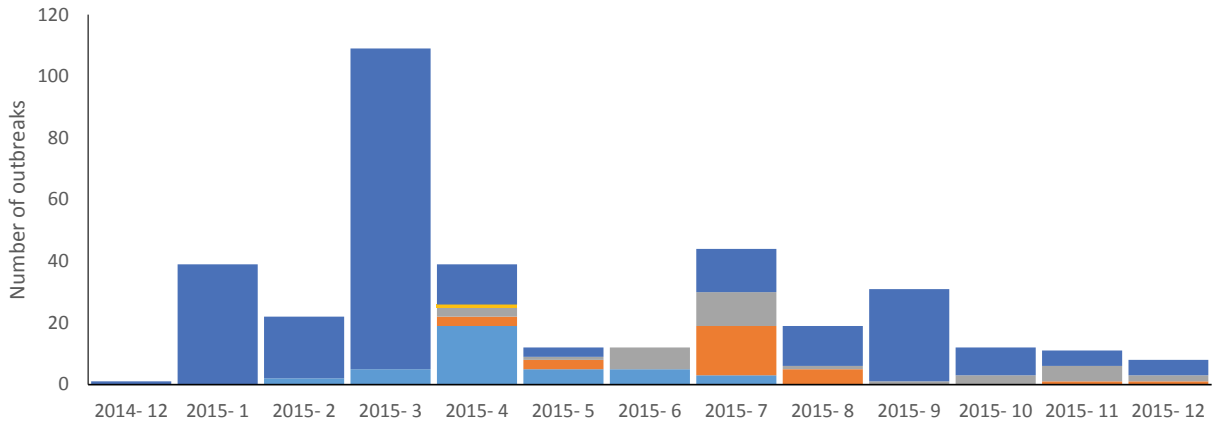
Avian Influenza (AI) - Global trends in zoonotic influenza (H5N1, H7N9 and other subtypes like H5N6)

In 2015, several high and low pathogenic (LP) H7, H5 and H9 AI viruses circulated in birds worldwide including in North and Central America, the Middle East, East and Southeast Asia, Africa and Europe. Spillover to humans was reported for H5N1 and H5N6 HPAI and for H7N9 and H9N2 LPAI (Figure 9). Influenza activities were particularly intense at the beginning of the year.

Among the serotypes of HPAI, H5N1 remains the most widely distributed and the one causing the majority of detected human cases. Endemic in most parts of South and Southeast Asia and in Egypt, this serotype was reported in at least 26 countries across 4 continents. In 2015, the H5N1 HPAI epidemiology was characterized by several incursions into non-endemic countries as well as continued spread in endemic countries. Also, the emergence of the new combination H5N1 HPAI reported in late 2014 (as results from the combination of the H5 gene from the Asian H5N8 HPAI virus with the N gene from native North American AI viruses found in wild birds) continued to have impact in the United States of America and Canada while another virus, resulting from mutation of European LPAI strains, emerged in France in 2015.

Incursion of H5N1 HPAI in West Africa: On 16 January 2015, Nigeria confirmed the presence of H5N1 HPAI to OIE. First observed in Lagos state at the end of December 2014, the virus spread rapidly in the country, affecting 13 of the 37 states within one month. This marked the first occurrence of H5N1 HPAI in the West African region since the last epidemic in 2006 to 2008. In February, the virus was detected in Burkina Faso, at end of March it made a brief incursion into the Niger and in April the virus was officially reported in Ghana and in Côte d'Ivoire (see Figure 6).

Figure 6. Monthly number of H5N1 HPAI outbreaks stratified by affected country, West Africa (2014–2015)



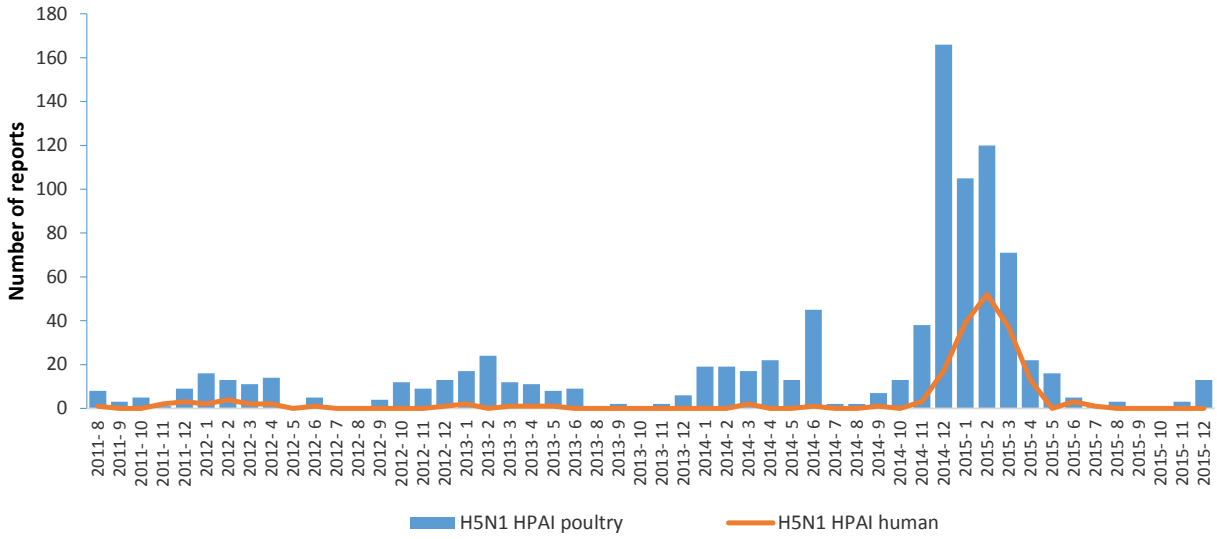
Nigeria remains the most severely affected country in the region. Outbreaks have been constantly reported in 2015 affecting all poultry sectors and one zoo. Areas affected are mainly in the central, north and southwest regions, mirroring the concentration of poultry populations in the country. As for the end of the year, the infection was reported in over 50 percent of the 37 states across Nigeria. Given the wide geographical range, the high number of outbreaks in recent weeks and the lack of effective control measures, H5N1 HPAI can be considered endemic in Nigeria. At the end of 2015, outbreaks in poultry have been reported also in Côte d'Ivoire and Ghana, but in a territory limited to the Abidjan region and Accra state, respectively.

The source of incursion of this H5N1 virus into West Africa is difficult to determine and may have been related to the informal poultry trade or to migratory bird movements. The virus has been identified as belonging to Clade 2.3.2.1c (Monne *et al.*, 2015) genetically similar to H5N1 HPAI viruses found in Asia in 2013–2014 and to the virus detected in wild birds and poultry in Bulgaria and Romania; the virus found in the Islamic Republic of Iran, Kazakhstan, the Russian Federation and Turkey on the westward flyway between Asia and Europe in 2015; and a virus found in wild birds.

Egypt and Near East: H5N1 HPAI activities have been particularly intense in the 2014–2015 season in Egypt. Between November 2014 and March 2015, the number of reported outbreaks/detections in poultry was five times higher than the median value observed in the previous five seasons, with the virus circulating in all sectors of poultry production and in all parts of Egypt. In the same period, an unprecedented increase in the number of human infections has been observed, with a number of H5N1 HPAI human cases 16 times the median number of human cases reported for the same period in the previous five seasons. The number of outbreaks reported in poultry was again within the pre-

viously observed range since April and the last human case in Egypt was reported in July. According to the World Health Organization (WHO) assessment, the increase in human cases was directly linked to the increased viral circulation in poultry, driving increased risk of human exposure to infected poultry, rather than to virus mutations and/or change in the way the virus was transmitted to humans (see http://www.emro.who.int/pdf/egy/egypt-news/upsurge-h5n1-human-poultry-cases-may-2015.pdf?ua=1). The figures observed in November and December suggest that the 2015–2016 H5N1 season will be milder compared to the previous season (see Figure 7).

Figure 7. Monthly number of H5N1 HPAI outbreaks in poultry and of H5N1 HPAI human cases in Egypt, August 2011 to December 2015



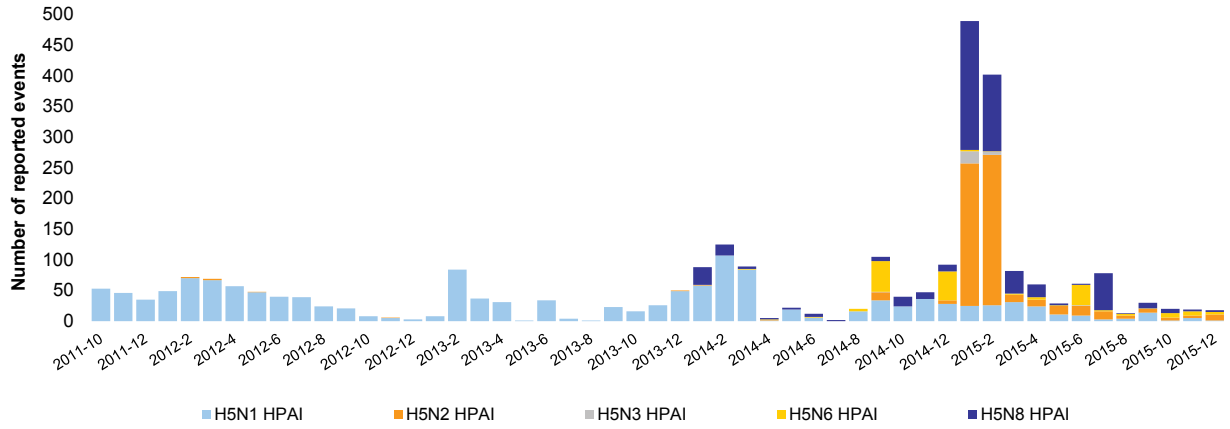
In Egypt, H5N1 was first reported in poultry in 2006. Inadequate control measures enable the virus to continue circulating and to mutate genetically and antigenically over the years, particularly after 2008 when the virus was declared to be enzootic.

From the initial subclade 2.2.1, different subclades emerged over the years. Viruses isolated in 2015 belonged to clade 2.2.1.2 (see http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=21085; Kayali *et al.*, 2016 http://wwwnc.cdc.gov/eid/article/22/3/15-0593_article).

H5N1 HPAI viruses clustering with those circulating in Egypt were isolated from outbreaks reported in Israel and The West Bank between January and March, and in Gaza Strip between April and August 2015.

East, South and Southeast Asia: H5N1 HPAI is endemic in birds in some countries in South, East and Southeast Asia while in other countries its epidemiology is characterized by regular but sporadic incursions of the virus. Human cases are reported annually. Noteworthily, the number of reporting countries and outbreaks/detections reported in birds and humans has decreased since 2012 (see Figure 8). This can reflect a decrease in viral circulation, but also a decrease in surveillance system sensitivity. In 2015, H5N1 HPAI was reported in birds in eight countries, with the majority of the events being reported in Cambodia, China,

Figure 8. Monthly number of HPAI outbreaks/detection in domestic and wild birds in southeastern Asia, October 2011 to December 2015

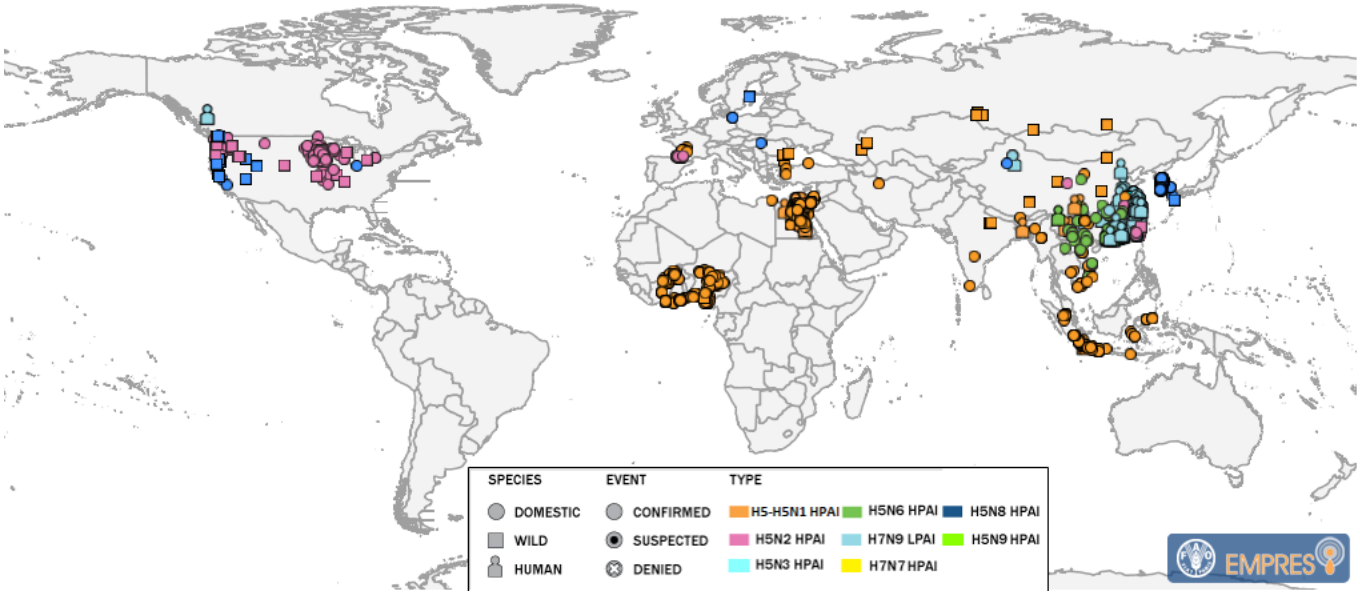


India, Indonesia and Vietnam. These are countries where the virus has been constantly reported since 2005. Incursion of the virus has been reported in Bhutan and the Islamic Republic of Iran and Myanmar. Human cases were registered in Bangladesh (1), China (6) and Indonesia (2). Viruses from different clades have been circulating in 2015: Asian clade 2.3.2.1a was detected in birds in Bhutan and Indonesia, while clade 2.3.2.1c affected birds and poultry in Cambodia, China, India, Indonesia and Vietnam; clade 2.3.4.2 was detected in Myanmar.

Beside H5N1, various influenza H5 HPAI subtypes, such as influenza H5N2 H5N3, H5N6 H5N8 and H5N9 have been detected in birds in Africa, the Americas and Europe. Although all the H5 HPAI might have the potential to cause disease in humans, to date, human cases of infection have been reported only with influenza H5N6 and only in China.

H5N6 HPAI has continued to circulate in the four previously affected countries in 2015. It has been reported throughout the year in Vietnam, China mainland and sporadically in Hong Kong (in wildlife) and in one poultry outbreak in Lao People's Democratic Republic. Noteworthily, five sporadic human cases with severe clinical symptoms were reported in China in 2015. Probably circulating in China since 2013, **H5N6** was first reported in a poultry outbreak in China in May 2014 and briefly identified in three neighbouring countries.

Figure 9. Map of relevant AI events in animals and humans reported globally (January–December 2015)



Emerging in January 2014, **H5N8 HPAI** virus shares the H5 gene with the H5N1 HPAI clade 2.3.4.4 viruses. In late 2014, the virus spread to the Americas and Europe where outbreaks in poultry and detection in wild birds have occurred in the first month of 2015. Meanwhile there have been **H5N8 HPAI** outbreaks in January and February 2015 in Japan and at a higher intensity in the Republic of Korea and in Taiwan, where the virus has continued to circulate at a lower intensity during the entire year.

Also, this virus has shown a predilection to reassort genetically with local LPAI strains giving rise to the emergence of new subtypes, particularly the North American **H5N8**, **H5N1** and **H5N2** HPAI as well as novel strains of **H5N2** and **H5N3 HPAI** in Taiwan Province of China. The latter, in particular, has caused more than 450 outbreaks in Taiwan Province of China from January to March and have been since then constantly circulating in the island in poultry and in wild birds.

Europe, **France**, **Germany** and the **United Kingdom of Great Britain and Northern Ireland** reported non-zoonotic H5 and H7 influenza virus subtypes. Germany and the United Kingdom of Great Britain and Northern Ireland reported **H7N7 HPAI**, with the virus showing close homology to the low pathogenic H7N7 viruses that have been circulating in Europe for some time, implying mutation from LPAI to HPAI. Mutation from LPAI to HPAI is the mechanism indicated to be also at the base of the **H5N1**, **H5N2** and **H5N9 HPAI** epizootic events ongoing since November in France in several departments in the southwest of the country.

H7N9 LPAI China: In 2015, **H7N9 LPAI** virus has continued to circulate in birds and to cause human cases, despite the fact that changes to hygiene practices in live poultry markets have been implemented in many provinces and municipalities. The occurrence of human cases followed the already previously described seasonal patterns with case numbers peaking during the November to March period. During the year, 190 human cases were reported from China, along with 4 other cases: 2 in Hong Kong and 2 in Canada, all involving individuals with a history of travel to China mainland. As previously observed, human cases have occurred mainly in the southwest provinces of China mirroring the concentration of poultry populations in the country, with Guangdong, Zhe-

jiang and Fujian the most affected in 2015. The same areas are those where the highest number of positivity in bird or environmental samples were reported as a result of the surveillance for avian influenza A(H7N9) viruses in poultry and live bird markets. The understanding of the epidemiology associated with this virus, including the main reservoirs of the virus and the extent of its geographic spread among animals, remains limited. However, it is likely that the virus continues to circulate in birds, and that humans acquire infection mainly through exposure to infected poultry or contaminated environments, including live bird markets. Information to date does not support sustained human-to-human transmission, although limited human-to-human transmission cannot be excluded in a very few human clusters. The majority of the influenza A(H7N9) viruses characterized so far remain antigenically similar to A/Anhui/1/2013 (see H7N9 LPAI risk assessment WHO February 2015). So far, the virus has not spread outside China.

Ebola in West Africa

In March 2014, an outbreak of Zaire Ebola virus was reported in Eastern Guinea, the first outbreak of Ebola virus in West Africa. Possibly emerging in December 2013, the disease spread rapidly in the three neighbouring countries, i.e. Guinea, Liberia and Sierra Leone, which, to date, have remained the most affected countries. The number of human cases in these countries peaked in autumn 2014 and has been progressively decreasing. Liberia was the first country to be declared free from the disease on 9 May 2015, Sierra Leone, on 7 November 2015 and Guinea, on 29 December 2015. At the end of 2015, Ebola virus disease (EVD) epidemiology has been characterized by re-emergence episodes triggered by virus persistence in survivors, as in the two episodes that **Liberia** experienced in June and in November. In West Africa, further EVD human cases might arise as a result of a missed transmission chain, reintroduction from an animal reservoir or re-emergence of virus that had persisted in a survivor.

This has been the largest documented EVD outbreak, both in terms of humans affected and geographical spread. As of 31 December 2015, WHO has reported 28 601 EVD cases (confirmed, suspected and probable cases) in the three most affected countries, including 11 300 deaths. An additional 32 cases, including 16 deaths, were reported from **Italy, Mali, Nigeria, Senegal, Spain,** the **United Kingdom of Great Britain and Northern Ireland** and the **United States of America**.

This outbreak resulted in second-order effects in food, including regional food insecurity in West Africa. In September 2014, the Food and Agriculture Organization of the United Nations (FAO) reported severe disruptions in food availability in Guinea, Liberia and Sierra Leone because of quarantine-imposed travel restrictions on sellers (which limited supply) and consumers (which impeded access) and panic buying (which decreased supply) all of which possibly contributed to dramatic price increases [FAO Global Information and Early Warning System (GIEWS)], Grave food security concerns following the Ebola outbreak in Guinea, Liberia and Sierra Leone [Internet]).

The definitive reservoir host of Ebola virus remains unknown, although, from an ecological perspective, it is understood that the virus first emerged from forest ecotypes interfacing with human activities. Ebola viruses affect a large range of mammalian species, from humans to wild and domestic animals. Fruit bats are considered likely natural hosts for Ebola virus in Africa. On the African continent, Ebola virus has been detected in the wild in carcasses of chimpanzees, gorillas and forest antelopes. Human infections have been linked to direct contact with gorillas, chimpanzees, monkeys, forest antelope and porcupines found dead in the rainforest. Pigs are the only species of livestock currently known to be susceptible to EVD. In addition, dogs were shown to develop an immune reaction to Ebola virus but were never associated with virus isolation or viral shedding. See the WHO Web site for a graph of confirmed human cases (http://www.who.int/csr/disease/ebola/en/).

Middle East respiratory syndrome Coronavirus (MERS-CoV)

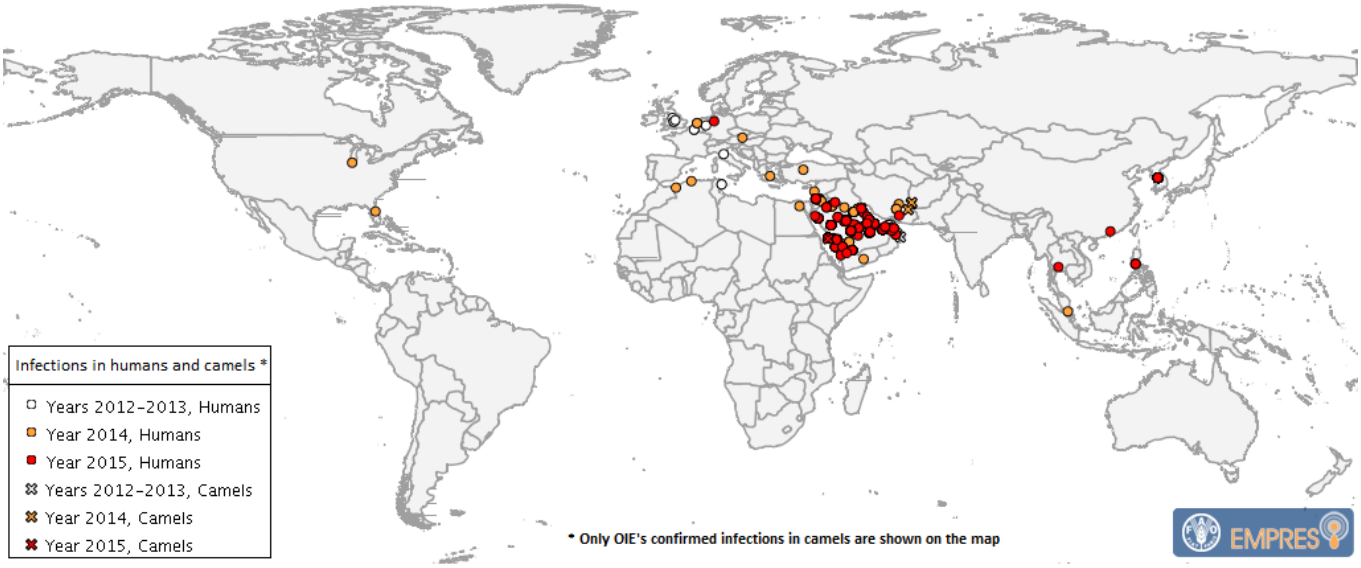
In 2015, MERS-CoV epidemiology in humans was characterized, as previously observed, by sporadic human infections followed by human-to-human transmission amplified among household contacts and contacts within healthcare settings. In 2015, over 650 Mers-CoV confirmed human cases, with at least 236 deaths, were reported in 12 countries globally, all with direct or indirect connection with the Middle East region. In the Middle East, **Saudi Arabia** has remained the country with the highest number of human cases (435 cases and, at least, 191 deaths) reported. A significant increase in cases was observed in the country in August and has been linked to the occurrence of a major nosocomial-related outbreak in Riyad. Nosocomial transmission was also the major driver of the cases that occurred in **Jordan** (Amman) between August and September. Other countries reporting cases in the region were t**he Islamic Republic of Iran** (1), **Kuwait** (1), **Oman** (4), **United Arab Emirates** (7) and **Qatar** (4).

Outside the Middle East, cases were registered in **China, Germany**, the **Philippines, the Republic of Korea** and **Thailand**. In **the Republic of Korea**, the largest human-to-human spread outside of the Middle East was observed; after a case returned to Seoul from Bahrain, the disease spread through different hospitals of the city due to human-to-human transmission among patients, health care workers and family members. In three months, 185 cases (and 36 deaths) were reported.

In 2015, samples collected in camels from a farm in Makkah Province in late December were officially reported to be PCR-positive from Saudi Arabia. This is the first time Saudi Arabia has officially reported the detection of MERS-CoV to OIE, although the virus was known to circulate in camels in the country as documented in literature. MERS-CoV detection in camels has been reported to OIE in the previous year from the Islamic Republic of Iran, Kuwait, Oman and Qatar. Antibodies against MERS-CoV (or another very similar virus) were detected in samples taken from camels in a number of countries in the Middle East, North Africa, East and West Africa and in the Canary Islands; some of these seropositive samples date back to 1992.

MERS-CoV was first identified in humans in 2012 in the Middle East. As of 2015 over 1 600 human cases of MERS-CoV, including more than 600 deaths, have been reported by local health authorities, predominantly in the Middle East region (see Figure 10). The source of the virus remains unknown, but the pattern of transmission and virological studies points towards dromedary camels in the Middle East being a reservoir from which humans sporadically become infected through zoonotic transmission. Positive PCR results for MERS-CoV or isolation of the virus from animals are notifiable to OIE because MERS-CoV is an emerging disease with a significant public health impact.

Figure 10. Global distribution of human and animal infections with MERS-CoV from September 2012 to December 2015



SECTION 2

Drivers of animal disease incursion and spread

Well-studied factors/drivers that influence the dynamics of animal and zoonotic diseases globally include changes in land use and thus agro-ecological dynamics; human behaviour and movements (including animals and food products), whether because of trade opportunities or cultural practices, or to escape civil unrest; intensification of contact between wildlife and livestock or human species because of urban expansion or environmental encroachment; unprecedented erratic fluctuations in climate; and the lack of access to goods and services in areas stricken by poverty and hunger, among others. This section describes briefly the observed changes in major drivers that could have influenced the pattern of disease observed during this reporting period (April to June 2015).

Given the complex nature of the interaction between drivers and disease occurrence, this section does not attempt to provide proof of association or causation, but highlights some key disease risk factors that may provide some insight into the incursion and spread of animal diseases in different ecosystems.

Agro-ecological drivers: The observed global and regional changes in **rainfall** and **temperature** during the reporting period are described here: http://www.fews.net/sites/default/files/documents/ reports/Global%20Weather%20Hazard-150625.pdf.

Rainfall and temperature are known to affect pathogen survival in the environment and disease vector behaviour. High temperatures and heavy seasonal rainfall as well as the presence of water (i.e. flooding, rivers etc.) are generally associated with an increase in arthropods which may increase the likelihood of transmission and occurrence of vector-borne diseases such as LSD, RVF and Trypanosomoses in areas where these diseases are endemic. But expansion can occur to new areas (non-endemic) because of climatic change. The persistence and stability of AI viruses increase as the result of low temperatures and high relative humidity in tropical settings. Additionally, wild bird migration patterns and their ability to spread diseases like H5N1 may be affected by climatic changes and thus alterations in migratory pathways. Dryness and low precipitation trigger livestock/pastoral movement and cause the congregation of livestock at water points and grazing areas, where wildlife species also occur. In these areas, the increased contact between different livestock herds and between domestic/wildlife species further increases the risk of disease spillover and spread in livestock and wildlife, e.g. FMD.

El Niño[1]**:** The global climate in 2015 was greatly influenced by strong El Niño conditions that developed during the year. El Niño increased since March peaking at a very high level of intensity during November/December 2015. It is considered to be the strongest El Niño since 1997–1998. As expected, its impact on weather patterns was different around the world (see Figure 11). **Drier than average** conditions were observed in **Central South** and **Southeast Asia** (north-central China, parts of India, Indonesia, the Philippines, Thailand and Vietnam), in **Australia** and **Papua New Guinea**, in **southern Africa**, along the **Gulf of Guinea** as well as in **Central America** and the **Caribbean,** and the **northeastern region of South America**. **Above average rainfall** occurred in **West Africa**, the **Sahel**, the **Horn of Africa**, **Central Asia** and the **Middle East**, **southern** and **eastern China** and the **southern region** of **South America**. The current El Niño event is well established. Most prediction models indicate slow weakening of El Niño conditions over the coming months, returning to neutral by late spring or early summer 2016, with a chance for La Niña development during fall. The update can be accessed here.

Precipitation: The year 2015 was very dry in many regions, including most of Brazil (except the southeast), **Central America** and the **Caribbean, Southeast Asia**, **Indonesia** and many Pacific island countries, and **Southern Africa**. It was wet in **West Africa** and the **Sahel**, in many subtropical parts of **South America**, and in areas of the southern **United States of America** and northern **Mexico**. In Europe, 2015 was dry in central and eastern parts of the continent, but wet in **Turkey**.

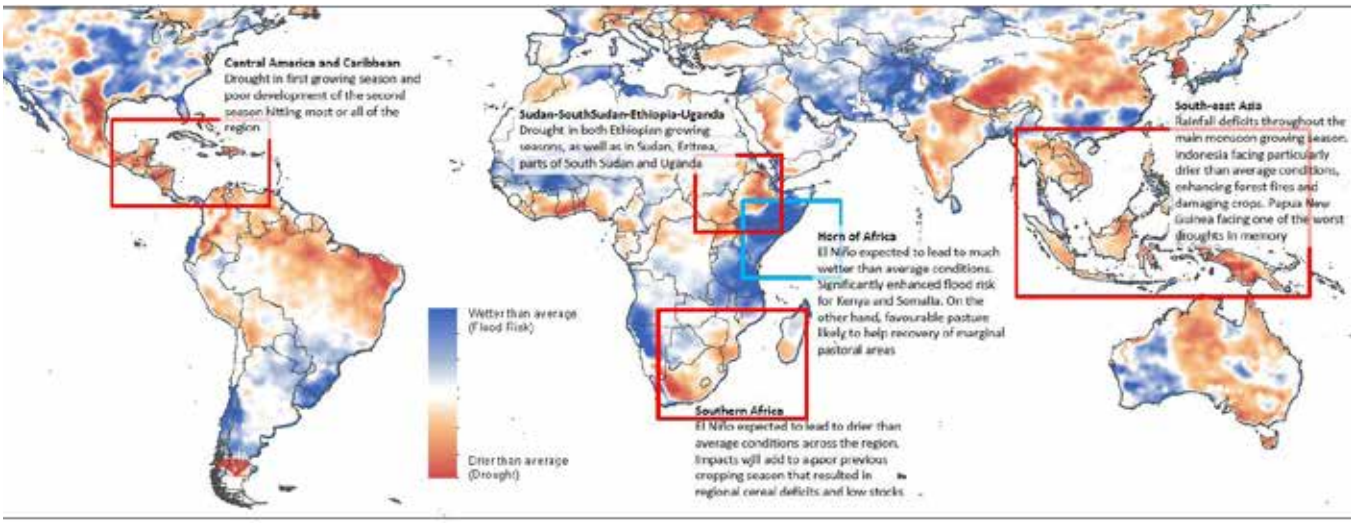
Temperature: The average global temperature across land and ocean surface areas for 2015 was 0.90 °C above the twentieth century average of 13.9 °C, surpassing the previous record warmth of 2014 by 0.16 °C. This is not only the highest calendar year temperature, but also the highest temperature for any 12-month period on record. These temperature anomalies were well above the anomalies observed in 1997 and 1998, where similar strong El Niño conditions occurred. Overall, the global annual temperature has increased at an average rate of 0.07 °C per decade since 1880 and at an average rate of 0.17 °C per decade since 1970. Many areas of the world experienced above-average annual temperatures (Figure 11). Record warmth was observed in Central America, the northern half of South America, parts of

1 El Niño is defined by prolonged warming in the Pacific Ocean sea surface temperatures (SST) when compared with the average value. The National Oceanic and Atmospheric Administration (NOAA) definition is a 3-month average warming of at least 0.5 °C in a specific area of the east-central tropical Pacific Ocean.

northern, southern and Eastern Europe stretching into western Asia, a large section of east central Siberia and regions of eastern and southern Africa. It was also much warmer than average in Australia, North Africa and North America. Only northeastern Canada and the very southern tip of Argentina were cooler than average. No land areas were recorded cold or even much cooler than average. A significant **heat wave** occurred in May and June 2015 during the pre-monsoon periods in India and Pakistan.

An overview of the climatic conditions by region for the year 2015 is given in Figure 11 and Annex 1.

Figure 11. Global El Niño impacts in 2015



Source: World Food Programme (WFP) Vulnerability Analysis and Mapping (VAM)

Festivals*:* In various countries around the world during 2015, several festivals were celebrated which are normally associated with increased movements of animals and animal products, and people.

A number of countries in South and Southeast Asia (including China, Myanmar, the Republic of Korea and Viet Nam) celebrated Chinese New Year in February – a period when an increase in live animal trade and movement was expected as a result of the increased demand for animal products. Increased livestock trade and animal movements during festive periods are normally associated with the increased possibility of disease spread (e.g. H5N1 HPAI) in countries such as Viet Nam and China. Several festivals took place in the second quarter (April to June) of 2015, including Easter, Lailat Al Miraj and Lailat Al Bara'ah in countries with notable Christian and Muslim populations, respectively.

The Ramadan and Eid festivities, celebrated throughout the Muslim communities around the world took place during the third quarter of the year (i.e June and early July 2015) and are normally characterized by large movements of people as well as foodstuffs, including live animals or animal products. Celebrations associated with the end of Ramadan - Eid-al-Fitr and Eid al-Adha - took palce in July and September, respectively, in countries with notable Muslim populations. During these two celebrations, large numbers of sheep and goats are marketed for feasting and celebrations. This may have increased the possibility of pathogen introduction and disease transmission among small ruminants during the festivities, including PPR, FMD and brucellosis, though there are no available data on this in the disease reports. Large (multimillion) aggregations of pilgrims for the observation of religious rites were also expected in the sacred city of Makkah in Saudi Arabia. This influx could also lead to the introduction of pathogens and their spread between humans given the close human-to-human contact (i.e. MERS-CoV, influenza and other emerging zoonotic or non-zoonotic diseases).

Animal trade: Intercountry trade during 2015 in live animals as recorded by the United Nations (cattle, sheep, poultry and camels) showed significant increases in export volumes for bovines, poultry and small ruminants, while a decrease was observed for camels compared to previous years (see Figure 12). A five-fold increase in pigs and a three-fold increase in poultry and bovines were observed during 2015 compared to 2014. Decreases in the number of camels imported were also observed. Overall, for 2015, there were more bovines and small ruminants exported than imported while more poultry and pigs were imported than exported. The major exporter of live bovines for 2015 was France (9.19 × 107 kg; 3.03 × US$108) to 28 countries, while Italy was the major importer (8.6 × 107 kg; 2.4 × US$108) from 18 countries. In terms of live poultry, Germany dominated both exports (3.37 × 107 kg; 4.29 × US$107) and imports (1.38 × 108 kg; 1.22 × US$108). Romania dominated both import and export trade of small ruminants for 2015. Denmark was the major exporter of live pigs (9.56 × US$107; 1.73 × US$108), while the Netherlands was a major importer (9.39 × 107 kg; 1.32 × US$108). Ethio-

pia was the major exporter of camels (5.93 × 106 kg; 2.64 × US$107) while Saudi Arabia was the largest importer of camels (3.12 × US$106; 2.33 × US$107).

The general trend in **global meat prices** for 2015 was a decrease: the meat price index in 2015 was 168.1, a decline from a value of 198.1 in 2014. During 2015, this index fluctuated as the result of changes in the prices for beef, mutton and pork. Price differentials across regions and borders increase incentive for unregulated animal and animal product-related movements and, therefore, increased risk of pathogen or disease spread.

Civil unrest: A number of events related to natural disasters and social unrest were observed which have had an impact on animal health conditions in countries across the globe (see Figure 13). Violence, radicalism and political instability were observed in several countries in North Africa (Egypt, Libya and Tunisia), Central and West Africa (the Central African Republic, Mali and Nigeria), West Central Asia (Afghanistan) and the Middle East (Lebanon, the Syrian Arab Republic and The West Bank). Such situations generally result in interruptions in activities and basic public services, including those related to public and animal health, leading to higher incidence of diseases going unreported and in their unmonitored and uncontrolled spread. Civil unrest also results in human population movements and the movements of live animals and animal products, with a change in the geographic distribution of the demand for animals and animal products and, therefore, trade and notable price differentials. Countries with higher levels of activities (i.e. those reporting more than two civil unrest events) include **Afghanistan, Egypt**, **Israel**, **Libya**, **Mali**, **Myanmar**, **Pakistan**, **South Sudan**, the **Syrian Arab Republic**, **The West Bank** and **Yemen**. In countries like **Nigeria**, where extremist anti-government groups are operating in specific geographic areas, and in **Libya**, where a functional government is absent, outbreaks of H5N1 HPAI have occurred.

Figure 12. Annual global trade in live animals: (a) net weight (in kg 100 000) of live animals exported globally per year (2012–2015); (b) net weight (in kg 100 000) of live animals imported globally per year (2012–2015)

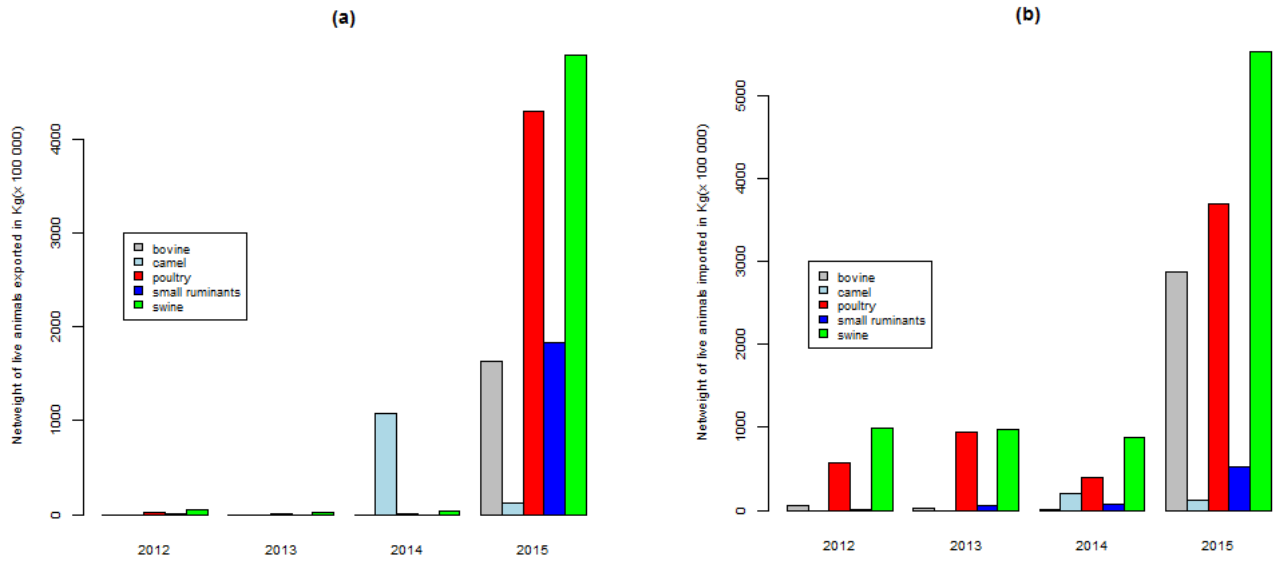
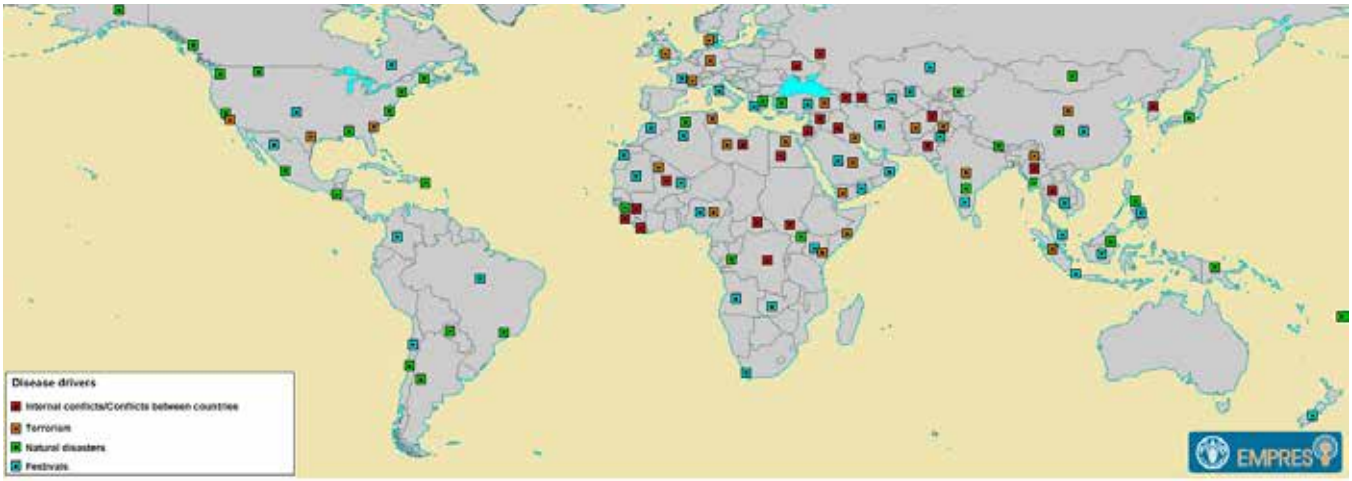


Figure 13. Map of selected disease drivers reported globally from January to December 2015



SECTION 3

Risk assessment

Lumpy Skin Disease (LSD)

The main possible pathways for LSD introduction from the affected regions of Greece into free areas are considered to be the movement of infected animals and vectors. Spread of LSD in Greece has been mitigated by the vaccination of susceptible animals and movement restrictions in the affected areas. Adverse weather conditions for the spread and viability of vectors further lessen the risk. The current situation in other countries is difficult to assess since there are not enough data available to determine the impact of the implementation of mitigation strategies.

Rift Valley fever (RVF)

West Africa

For all RVF-affected regions in Mauritania, the precipitation pattern observed during the 2015 rainy season was similar to that observed in the region during previous outbreaks: above-average precipitation with a peak during mid to late August, a dry spell of about seven days between September and October, followed by intensive rainfall of above 10 mm per day, which could have triggered massive hatching of mosquito eggs in this region (Soti *et al.*, 2012). Positive Normalized Difference Vegetation Index (NDVI) anomalies from September to October 2015 also confirmed suitable environmental conditions for mosquito amplification and disease transmission. As shown in Figure 14, the four RVF-affected provinces experienced more than 300 mm above average cumulative rainfall.

East Africa

During the past twelve months the Goddard Space Flight Center (GSFC) of the National Aeronautics and Space Administration (NASA), FAO, WHO, OIE and other partners have been closely monitoring climatic and vegetation conditions to forecast the risk of RVF vector amplification in East Africa and have provided recommendations and early warning messages for the region. Two *EMPRES Watch* issues were published to warn countries about RVF (FAO, 2014; FAO, 2015). Since September 2015, with the onset of the rainy season and the increased strength of El Niño, weekly RVF risk assessments and RVF risk maps have been provided to colleagues and partners in East Africa to better target preparedness and control activities on the ground. During the past months, persistent above-normal rainfall and flooding occurred in many parts of East Africa determining suitable environmental and climatic conditions for vector amplification and potential disease transmission. As a consequence, a number of activities and actions regarding RVF awareness, preparedness and control have been undertaken at regional and local levels, including training of veterinary and medical officers, vaccination of domestic livestock (Kenya), active and passive surveillance, and awareness creation. No human or animal cases have been detected and reported so far. However, given the persistence of suitable climatic conditions (see Figure 14), certain areas in the northern part of the United Republic of Tanzania, southern Kenya, central Somalia and South Sudan still remained at risk of RVF during the wet season (see Figures 15 and 16).

Figure 14. RVF cases in livestock (red) and provinces with human cases (grey polygons) during September–October 2015 overlaid on cumulative rainfall anomalies for September–October–November 2015

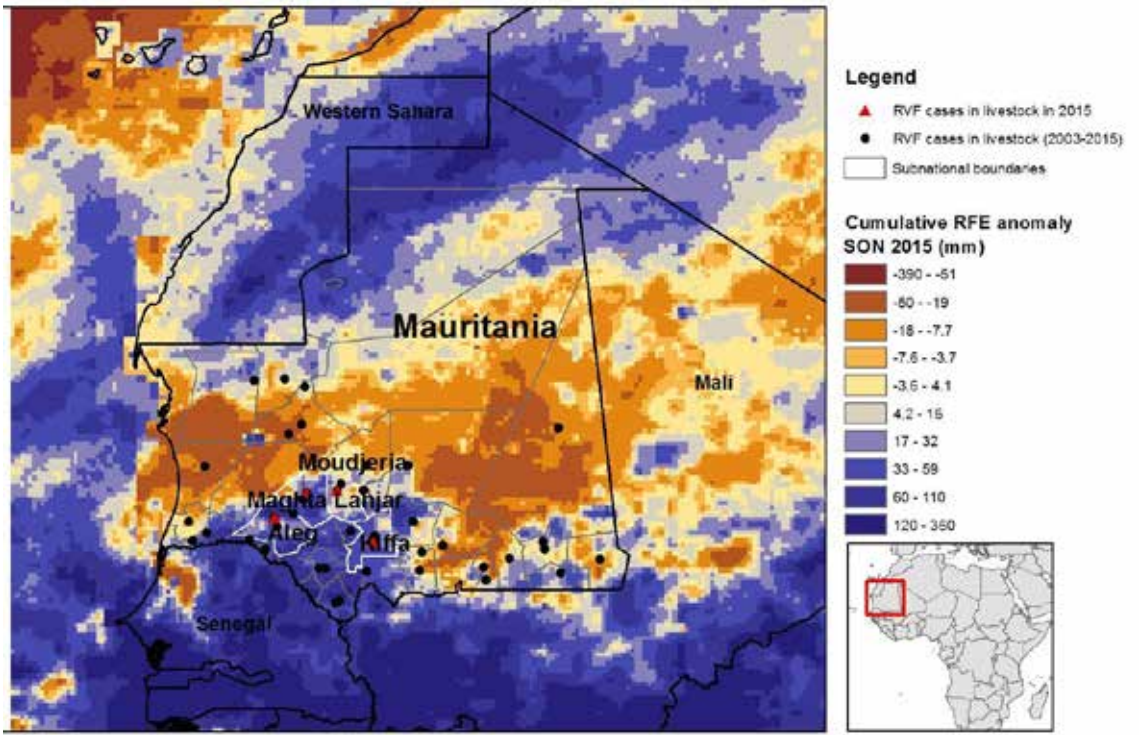
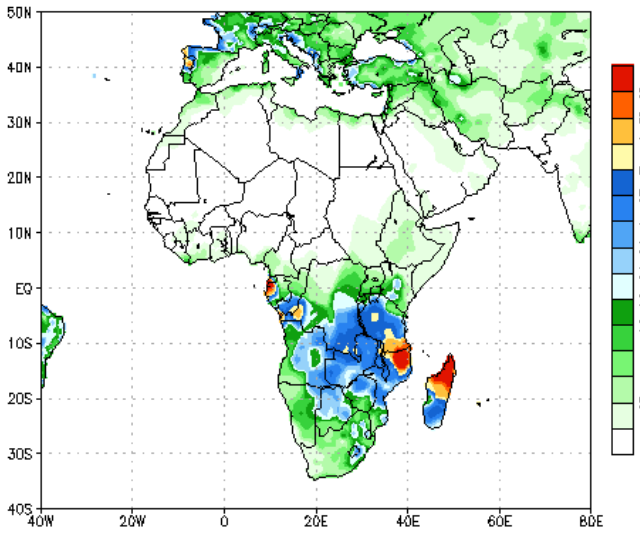
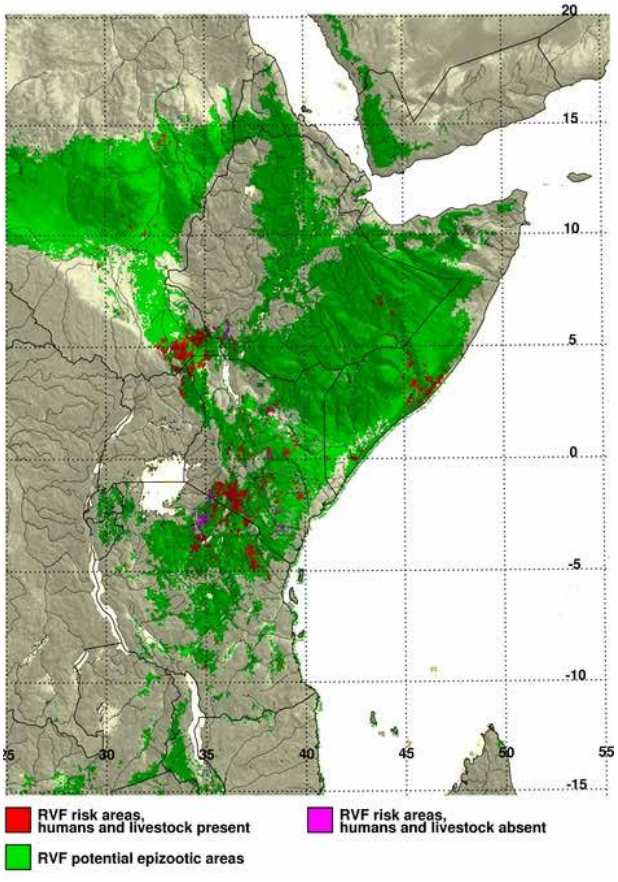


Figure 15. Cumulative rainfall from 8 December 2015 to 6 March 2016



Source: National Oceanic and Atmospheric Administration (NOAA)

Figure 16. RVF risk map for December–January–February 2016



Source: GIMMS Group, NASA Goddard Space Flight Center

H5N1 HPAI in West Africa

Of the five countries – Burkina Faso, Côte d'Ivoire, Ghana, Nigeria and the Niger – that reported H5N1 HPAI outbreaks in West Africa, three (Côte d'Ivoire, Ghana, Nigeria) experienced continued outbreaks up to December 2015 while one (Burkina Faso) reported outbreaks up to July. The Niger experienced sporadic cases (See Figure 17a). Outbreaks were reported from 355 unique locations across the five affected countries in 2015 and the presence of H5N1 HPAI was driven mainly by extensive poultry numbers (percent contribution to a risk model was 91.7) compared to intensive poultry numbers (percent contribution to a risk model was 8.3). Predictions of HPAI presence based on extensive and intensive poultry populations show that multiple areas that have not reported outbreaks are potential areas where the virus could be present. In Nigeria, areas identified with high probabilities include those in the central north and across the south regions; areas in the south of Benin and Togo, and areas in the south of Ghana and in small areas on the border with Burkina Faso. Central parts of Burkina Faso were identified as high H5N1 presence areas (See Figure 17b).

Figure 17a. Epidemic curves of H5N1 HPAI outbreaks reported in West Africa between December 2014 and December 2015

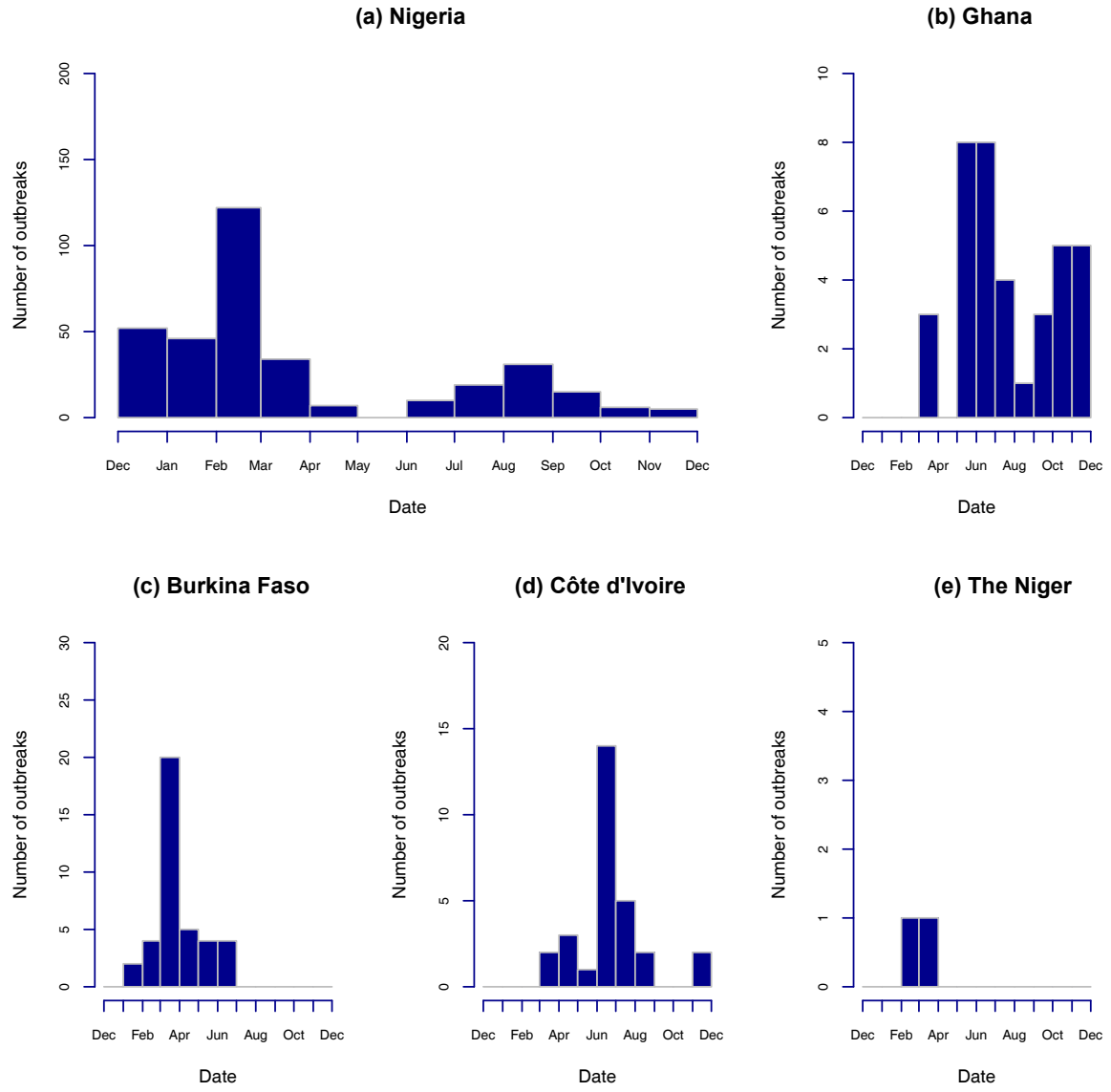
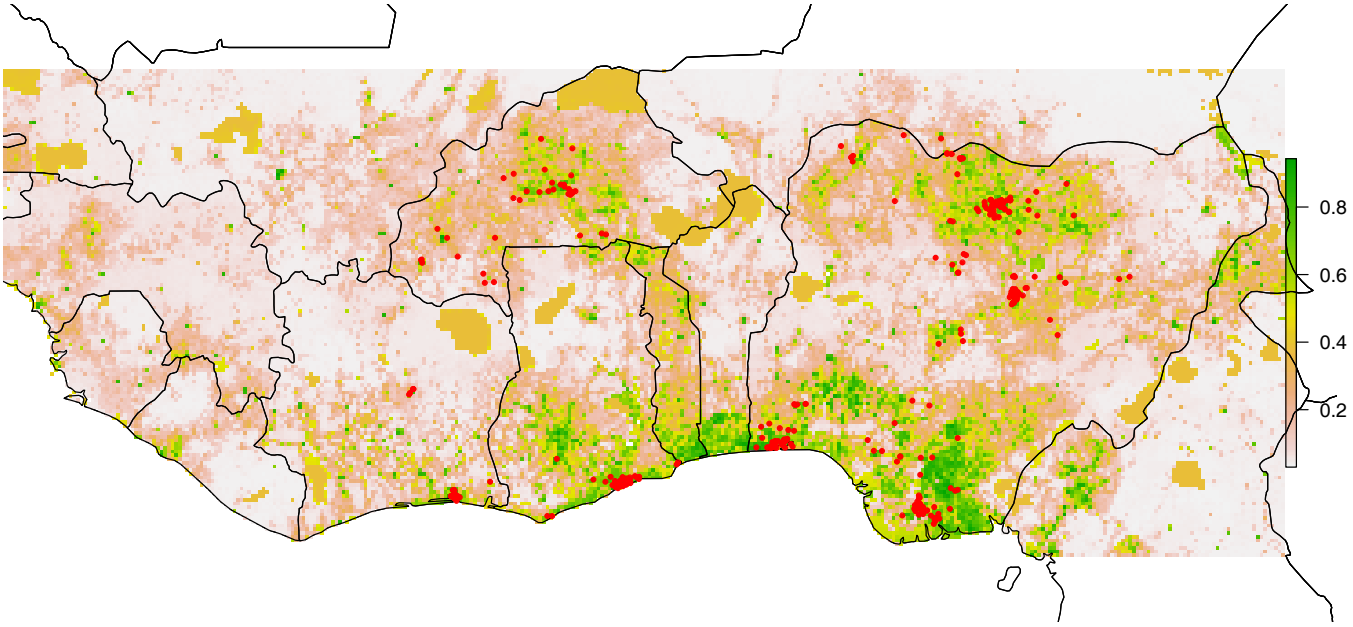


Figure 17b. Predicted presence of H5N1 HPAI in West Africa with point location of outbreaks reported during 2015 shown in red



SECTION 4

New publications or articles

Influenza

Monne, I., Meseko, C., Joannis, T., Shittu, I., Ahmed, M., Tassoni, L., Fusaro, A. & Cattoli, G. 2015. Highly Pathogenic Avian Influenza A(H5N1) virus in poultry, Nigeria, 2015. *Emerg Infect Dis.*, 21(7): 1275–1277.

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Ebola

FAO. 2015. *Addressing Zaire Ebola virus (EBV) outbreaks; Rapid qualitative exposure and release assessment. Rome* (available at www.fao.org/3/a-i4364e.pdf).

MERS-CoV

EC-EFSA workshop on research gap analysis in animal influenza – summary report. 2015 (available at ec.europa.eu/programmes/horizon2020/en/news/major-knowledge-gaps-yet-be-filled-fight-animal-influenza).

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Verhagen, J.H., van der Jeurd, H.P., Nolet, B.A., Slaterus, R., Kharitonov, S.P., de Vries, P.P., Vuong, O., Majoor, F., Kuiken, T. & Fouchier, R.A. 2015. Wild bird surveillance around outbreaks of highly pathogenic avian influenza A(H5N8) virus in the Netherlands, 2014, within the context of global flyways. *Eurosurveillance*, 20 (12) (available at www.eurosurveillance.org/ViewArticle.aspx?ArticleId=21069).

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EMPRES-i
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EUFMD monthly reports
http://www.fao.org/ag/againfo/commissions/eufmd/commissions/eufmd-home/fmd-surveillance/situation-reports/en/

FAO EMPRES Watch
Emergence of lumpy skin disease in the Eastern Mediterranean Basin countries:
http://www.fao.org/docrep/019/aq706e/aq706e.pdf

FAO Food Chain Crisis Management Framework - Early Warning Bulletin
http://www.fao.org/foodchain/empres-prevention-and-early-warning/early-warning-bulletin/en/

FAO World Food Situation
http://www.fao.org/worldfoodsituation/foodpricesindex/en/

Famine Early Warning Systems Network (FEWS NET) Global weather hazards summary
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State of the Climate: Global Analysis for May 2015, published online June 2015:
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Annex 1. Climate overview for the year 2015

Region	Climate overview
WEST AFRICA	After a very poor start to the rainy season in early 2015, the region experienced wetter than average conditions and a later than usual end of season. From August to early November 2015, heavy, abnormal and torrential rains and floods were observed across West Africa, particularly in Burkina Faso, Guinea, western Mali, southern Mauritania, western parts of the Niger and Senegal. Drier than average conditions were observed along the Gulf of Guinea, particularly in the southern half of Ghana, southern Nigeria and southwestern Cameroon.
EAST AFRICA	Since March 2015, the region was significantly influenced by the effect of El Niño. The first quarter of 2015 was characterized by drier than average conditions, particularly in central and northern Ethiopia, Eritrea, the Sudan and South Sudan. From March to June 2015, above-average rainfall was observed in southeastern Ethiopia, Kenya, southern Somalia, southern Sudan and South Sudan, Uganda and many parts of the United Republic of Tanzania. Heavy rains and floods occurred in Narok (Kenya) and Dar Es Salaam (United Republic of Tanzania). From late October through December 2015, heavy rains and floods were observed in Ethiopia, Kenya, southern and central Somalia, southern Sudan and northern South Sudan, Torrential rains caused floods in Kenya, Somalia and the United Republic of Tanzania.
SOUTHERN AFRICA	The first quarter of 2015 was characterized by heavy rains and extensive flooding in Madagascar, Malawi and Mozambique, as well as by abnormal persistent dryness in many areas of southern Africa. During the second quarter of 2015, above-average rainfall occurred in Botswana, costal South Africa, Zambia and Zimbabwe. Since the second half of 2015, the region was heavily affected by drier than average conditions caused by El Niño. Severe dryness was observed in Angola, Namibia, South Africa, Zambia and Zimbabwe.
NORTH AFRICA AND MIDDLE EAST	Between August and October 2015, wetter than average conditions were observed in northern Algeria, Morocco and Tunisia. Above average rainfall during the same period also occurred in Afghanistan, Kazakhstan, Pakistan, Tajikistan and Yemen. Since October, a persistent cold front occurred in Kazakhstan, Turkmenistan and Uzbekistan, causing heavy rain and snowfall.
ASIA	The general tendency across Asia during 2015 was for drier than average conditions, particularly in parts of India and north-central China. Above average rainfall has been limited to northwestern and southeastern China. A heatwave occurred in India from mid-May to June 2015.
SE ASIA AND THE PACIFIC	Below average rainfall and dryness dominated across Southeast Asia (from northern Burma to southern Vietnam), Australia, Indonesia, Papua New Guinea and the Philippines.
EUROPE	The region was warmer and drier than average.
CARIBBEAN, CENTRAL AND SOUTH AMERICA	Due to the strong El Niño conditions, Central America and the Caribbean were characterized by long periods of dryness throughout the year, except for the passage of the tropical storm Erika in late August that caused landslides and floods, particularly in the islands, including Dominica. In South America, persistent and severe drier than average conditions were observed particularly in northeastern Brazil, most of Bolivia, Columbia and Peru. In contrast, the eastern coastal areas have been wetter than usual and in southern Brazil and Paraguay above-average rainfall has been the norm.
NORTH AMERICA	North America was much warmer and drier than average, except for some parts of Canada that were colder than average, particularly the northeastern area.

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