Food and Agriculture Organization of the United Nations

March 2017

ANIMAL HEALTH **RISK ANALYSIS** ASSESSMENT No. **1**

RIFT VALLEY FEVER IN NIGER

Risk assessment

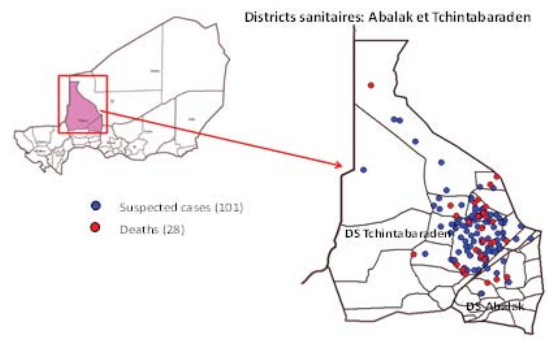
SUMMARY

- In the view of the experts participating in this risk assessment, Rift Valley Fever (RVF) in Niger currently poses a medium risk (a mean score of 5.75 on a scale of 0 to 10) to human health, and a medium–high risk (a mean score of 6.5) to animal health.
- The experts take the view that RVF is likely / very likely (a 66%–99% chance range) to occur in Mali during this vector season. Its occurrence in the neighbouring countries of Benin, Burkina Faso and Nigeria is considered less probable – between unlikely (a 10%–30% chance) and as likely as not (a 33%–66% chance).
- The experts are of the opinion that RVF is unlikely to spread into Algeria, Libya or Morocco in the next three to five years.
- Animal movements, trade and changes in weather conditions are the main risk factors in RVF (re)occurring in West Africa and spreading to unaffected areas.
- Improving human health and the capacities of veterinary services to recognize the clinical signs of RVF in humans and animals are crucial for rapid RVF detection and response.
- Finally, to prevent human infection, the most feasible measure is to put in place communication campaigns for farmers and the general public.

EPIDEMIOLOGICAL SITUATION

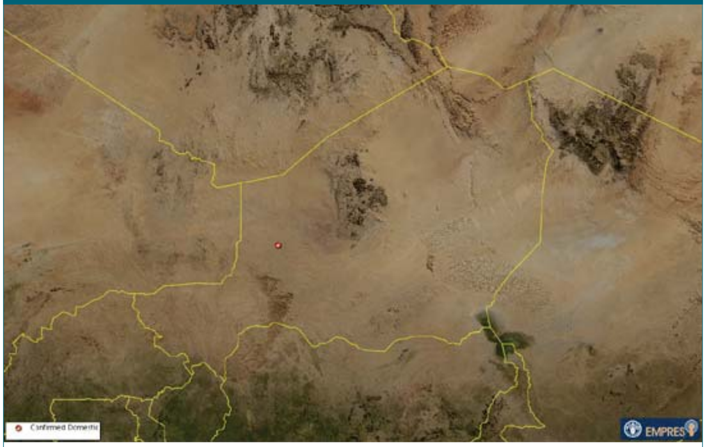
Between 2 August and 9 October 2016, Niger reported 101 human cases of suspected RVF, including 28 deaths. All RVF cases were in Tchintabaraden and Abalak health districts in the Tahoua region (Figure 1). The epidemic is ongoing. One RVF outbreak affecting cattle and small ruminants in Tansala village in Tahoua region, was officially reported to the World Organisation for Animal Health (OIE) on 19 September 2016 (Figure 2). Annex 1 gives further details of the RVF outbreak in Niger.

FIGURE 1. *Human cases of RVF in Niger*



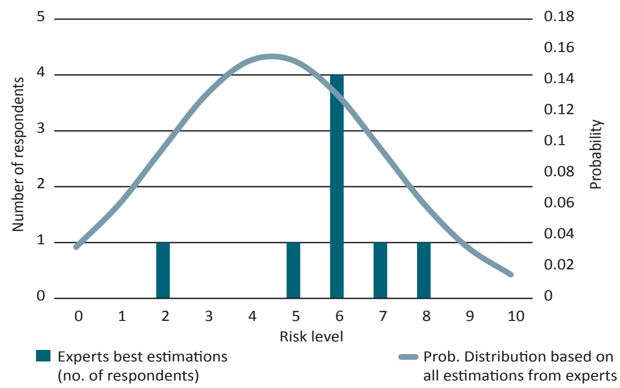
Source: Reproduced with permission from WHO Regional Office for Africa (AFRO)

FIGURE 2. *Location of Niger's animal RVF outbreak*



Note: Outbreak officially notified to OIE on 19 September 2016.

FIGURE 3. *Risk levels for human cases of RVF*



RISK ASSESSMENT

Five general questions about risk and with nine specific sub-questions were put to a group of FAO and external RVF experts.

For each sub-question a standard grid was used to gather the responses (see Annex 2 for details).

Experts consulted

The questionnaire was submitted to 15 experts from FAO and ten external experts. Responses were received from external experts Pierre Formenty (WHO), Stéphane de La Rocque (OIE, WHO) and Moustapha Lo Modou (Senegal) and from FAO experts Julio Pinto, Caryl Lockhart, Sean Shadomy, Ludovic Plee, Martina Escher, Lassina Ouattara and Paolo Calistri. Eight experts provided answers through the online form, and two responded on paper. The results of the consultation are described below.

Results

Responses are presented for each question and sub-question.

1. What are the expected / potential consequences for public and animal health in Niger in the upcoming months, in the event that no effective control measures are put in place?

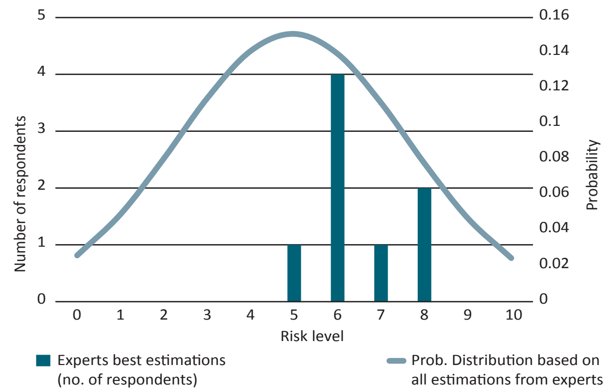
a. What is the risk of human RVF cases (assuming a 100% detection of human cases by the current surveillance and notification system) during this outbreak in Niger?

Using the risk matrix scale of 0 to 10, the experts' best estimations as to the consequences of RVF for public and animal health in Niger resulted in a mean score of 5.75. The scores ranged from a minimum value of 2 to a maximum of 8, indicating the variability in their views (Figure 3).

This mean score of 5.75 indicates that the public health consequences of RVF infection in Niger are medium-risk overall.

The range for public health impact with the higher mean probability was moderate – between 200 and 500 expected human cases.

FIGURE 4. *Risk levels for animal health impacts*



b. What are the expected impacts on animal health and production from this RVF outbreak in Niger?

According to the experts' best estimations, the most probable impacts of RVF on animal health in Niger resulted in a mean score of 6.5 – a minimum value of 5 and a maximum of 8 (see Figure 4). These values indicate that the RVF outbreak poses a medium-high risk to animal health and production.

2. What is the risk of the RVF outbreak spreading in the coming months into Mali, Burkina Faso, Benin or Nigeria?

a. What is the risk of having one or more RVF cases in humans/animals in Mali, Burkina Faso, Benin or Nigeria during this vector season?

The seven risk levels were defined as follows:

- Extremely unlikely (0%–1% chance) = 0
- Very unlikely (1%–10% chance) = 1
- Unlikely (10%–30% chance) = 2
- As likely as not (33%–66% chance) = 3
- Likely (66%–90% chance) = 4
- Very likely (90%–99% chance) = 5
- Extremely likely (99%-100% chance) = 6

The experts' best estimations suggest that RVF cases in Mali are more probable (with a mean score of 4.62) than in the other neighbouring countries, with the following mean scores: Burkina Faso 3.12, Benin 2.75 and Nigeria 2.87 (Figure 5).

When all the values are considered, larger variability in the estimations for Mali are evident (Figure 5 – probability distribution). These corroborate the higher levels of probability for RVF spreading to Mali, in contrast to the other three countries.

3. In view of the repeated outbreaks of RVF in recent years in other West African countries, what is the risk of RVF virus infection spreading to Algeria, Libya or Morocco in the next 3–5 years?

a. What is the risk of RVF virus spreading into Algeria, Libya or Morocco during the next 3–5 years?

On the basis of the seven risk levels defined in the previous question, the experts indicated similar levels of risk for the spread of RVF virus – Algeria 2.87 Libya 2.87 and Morocco 2.0 (Figure 6). This risk level is corroborated when all values reported by the experts are taken into consideration (Figure 6 – probability distribution curves).

b. What is the risk of the RVF virus persisting and spreading once introduced into Algeria, Libya or Morocco during the next 3–5 years?

In the view of the experts, the probabilities of the RVF virus spreading once reaching Algeria, Libya or Morocco are similar. This indicates comparable risk levels, with mean scores of Algeria 2.62, Libya 2.75 and Morocco 2.5 (Figure 7). This risk level is corroborated when all values reported by the experts are taken into consideration (Figure 7 – distribution of probability curves).

The experts' best estimations are more variable for the probability of RVF virus **persistence**, although we can see similar mean likely risk levels of 2.75 for Algeria, 2.87 for Libya and 2.87 for Morocco (Figure 8). This probability echoes the result when all values reported by the experts are taken into consideration (Figure 8 – probability distribution curves).

FIGURE 5. *Likely risk of RVF human / animal cases in neighbouring countries*

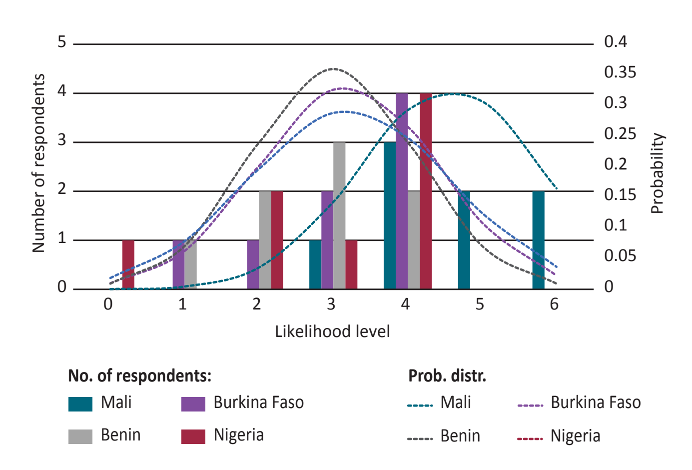


FIGURE 6. *Likely risk of RVF spreading to Morocco, Algeria or Libya*

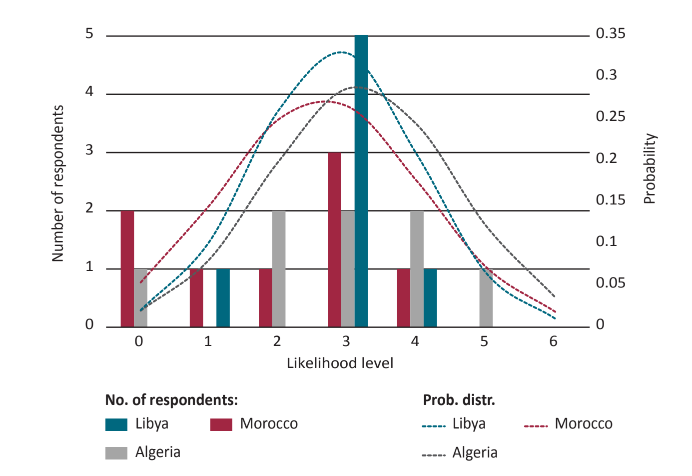


FIGURE 7. *Risk of the RVF outbreak spreading into Morocco, Algeria or Libya*

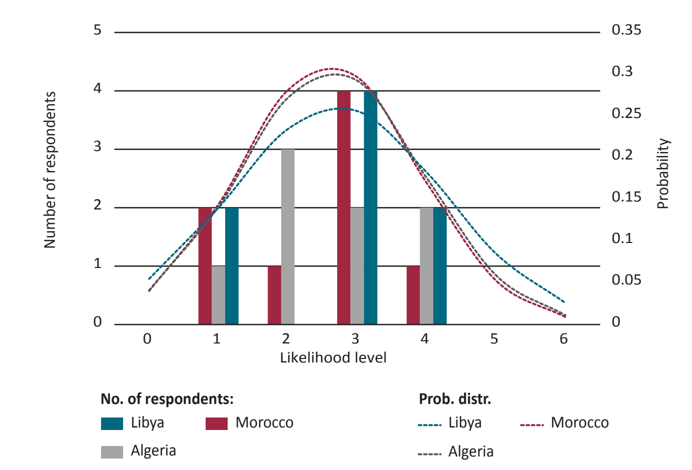


FIGURE 8. *Risk of RVF persisting in Algeria, Morocco or Libya*

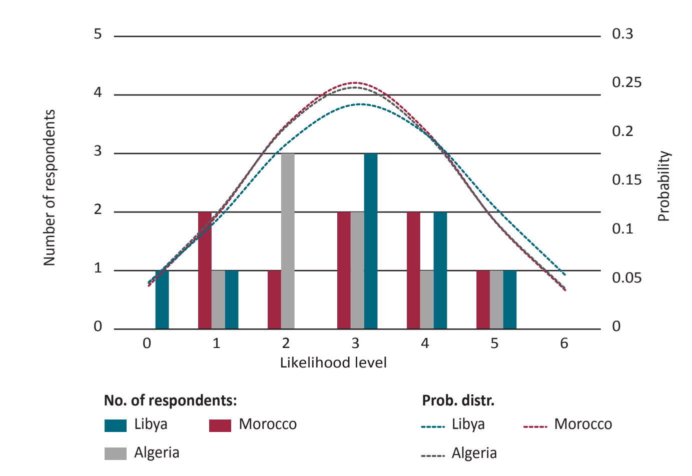


FIGURE 9. *Mean, minimum and maximum risks values for RVF (re)occurrence in previously infected countries*

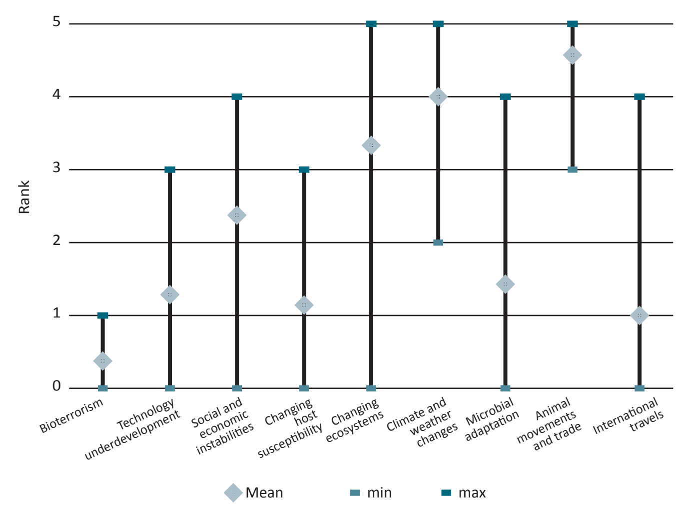
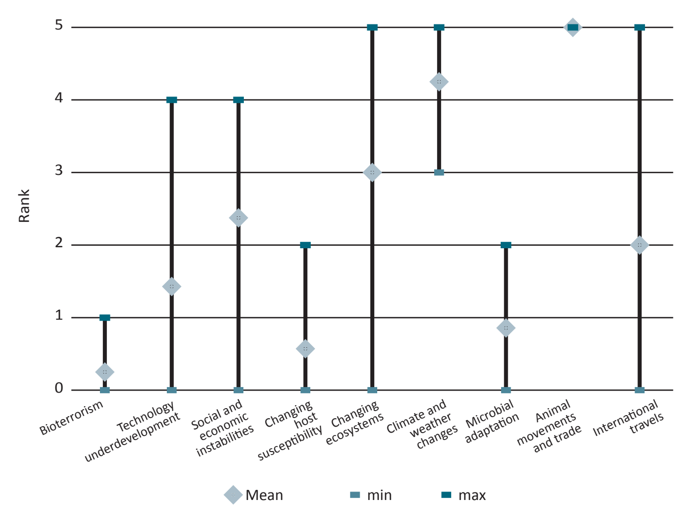


FIGURE 10. *Risk factors for the spread of RVF into new areas*



4. What risk factors play a significant role in the occurrence, persistence and spread of the RVF infection in West Africa?

The following list of risk factors and drivers was submitted for the experts' evaluation: bioterrorism, technology underdevelopment, social and economic instabilities, changing host susceptibility, changing ecosystems, climate and weather changes, microbial adaptation, animal movements and trade, and international travel. A six-level ranking system (with 0 as least relevant and 5 as most relevant factor) was used for this assessment.

a. Please rank, from most to least relevant, the risk factors and drivers for (re)occurrence of RVF infection in West African countries and areas with a history of RVF infection or outbreak.

The most relevant factor in the (re)occurrence of RVF in West African countries with a history of the infection was considered to be animal movements and trade. The least relevant factor was considered to be "bioterrorism". For the other risk factors, there was a wider range of answers by experts (Figure 9).

b. Please rank from most to least relevant the risk factors and drivers for the spread of RVF infection into new areas of West Africa.

The same risk factors were submitted to the experts to evaluate their relevance to the spread of RVF into new areas. Animal movements and trade were agreed as the major factors facilitating the spread of RVF; climate and weather changes were indicated as a significant driver for the spread of RVF (Figure 10).

5. What control measures could be put in place to reduce the risk of RVF virus infection in West Africa?

a. Please rank from most to least feasible and from most to least effective measures to increase the rapidity of the response to RVF infection.

The following control measures were considered:

- Improving veterinary diagnostic laboratories
- Enhancing veterinary capacity to recognize clinical signs of RVF in animals
- Improving public health diagnostic laboratories
- Increasing medical capacity to recognize clinical signs of RVF in humans
- Developing risk assessment forecasting models
- Developing early-warning systems based on regular animal testing: examples include sentinels and cross-sectional testing.

A six-level ranking system (0 = least relevant, 5 = most relevant factor) was used.

Improving the capacity of medical and veterinary services to recognize the clinical signs of RVF in humans and animals emerged as the most feasible measure to increase the rapidity of the response in case of RVF infection (Figure 11). The experts' responses were more variable for the above measures in relation to their effectiveness (Figure 12).

b. Please rank, from most to least feasible and from most to least effective, the preventive and control options for reducing the impact of RVF infection.

The following preventive and control options were considered:

- Culling of sick and infected animals
- Elimination of insects and control of mosquitoes
- Mass vaccination of animals
- Vaccination of infected flocks/herds only
- Partial stamping out: culling of sick animals and vaccination of remaining animals
- Public communication campaigns on reducing exposure to mosquito bites
- Communication campaigns for farmers and other animal-related professionals on reducing the risk of animal-sourced infections.

FIGURE 11. *Feasibility of applying measures to increase rapid response in case of RVF infection*

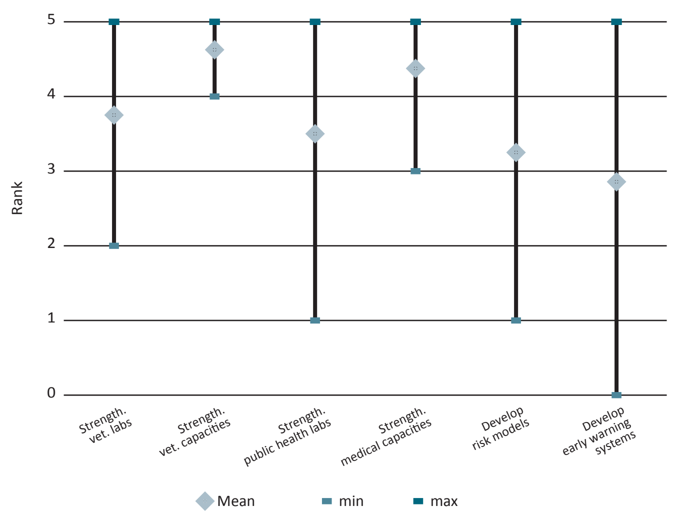


FIGURE 12. *Effectiveness of measures to increase rapid response in case of RVF infection*

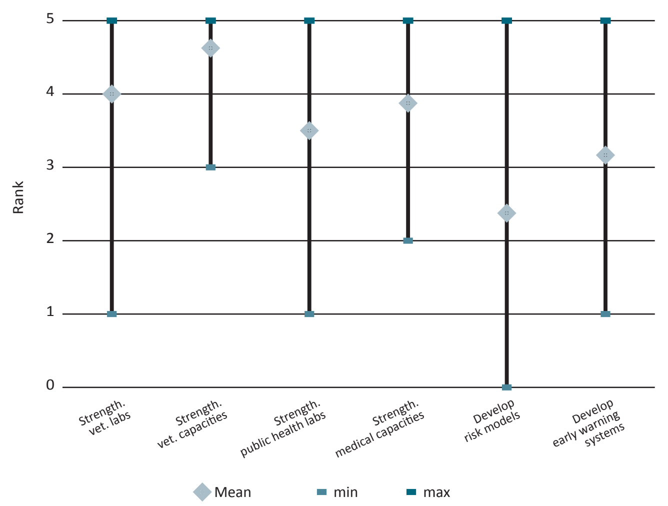


FIGURE 13. *Feasibility of applying preventive and control measures for RVF*

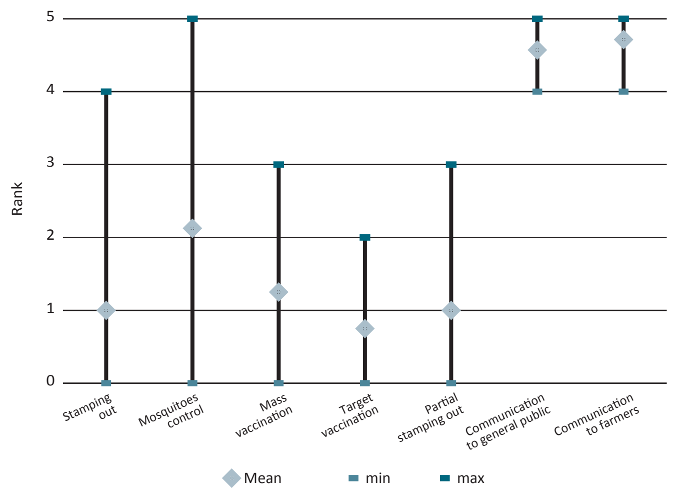
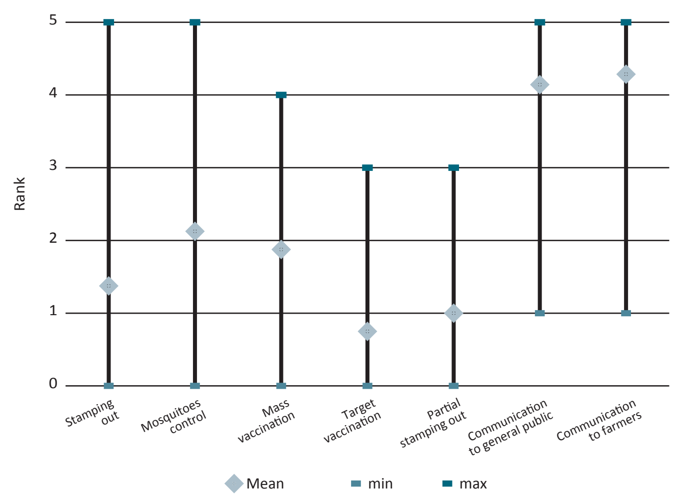


FIGURE 14. *Effectiveness of preventive and control measures for RVF*



A six-level ranking system (0 = least relevant, 5 = most relevant factor) was used.

The experts considered communication campaigns aimed at farmers and the general public as the most feasible preventive and control action in case of RVF infection (Figure 13). Again, the experts' responses were more variable for the above measures in relation to their effectiveness (Figure 14).

DISCUSSION

Although this risk assessment is based on the knowledge and evaluations made in a brief period by a limited number of experts, it provides useful indications about the risks posed by the ongoing RVF epidemic in Niger and about possible future scenarios in Niger and neighbouring countries.

The uncertainties of the experts' evaluations, must be taken into account. Increasing the number of experts could reduce the observed uncertainty in the estimations, but only for non-controversial questions.

The experts considered that the current situation in Niger poses a medium risk (mean score of 5.75 on a scale of 0 to 10) for public health and a medium–high risk (mean score of 6.5) for animal health. This is particularly relevant considering that the status of RVF in Niger's animal population remains highly uncertain, with only one outbreak officially notified to the OIE.

The occurrence of RVF in Mali during this vector season is considered "likely / very likely" (66%–99% chance) by the experts. Occurrence in Burkina Faso, Benin and Nigeria is between "unlikely" and "as likely as not".

The experts considered it unlikely that RVF would spread into north African countries in the next three to five years (10%– 30% chance). There is considerable variability in the experts' answers to this specific question.

Animal movement, trade and changes in weather and environmental conditions are considered to be the main risk factors in relation to the (re)occurrence of RVF in West Africa and its spread to previously unaffected areas.

For rapid RVF detection and response, the most important measure is enhancement of the capacity of medical and veterinary services to recognize the clinical signs of RVF in humans and animals.

Finally, to prevent human infection and increase awareness among local farming communities, the most feasible measure is to implement communication campaigns for farmers and the general public. Most of the human RVF cases reported in Niger so far are associated with livestock farmers.

Annex 1
THE SITUATION IN NIGER

On 30 August 2016, WHO received reports of unexplained deaths among humans along with deaths and abortions in cattle and sheep in northwestern Niger (Figure 15) and areas bordering Mali.

Between 2 August to 9 October 2016, 101 human cases were reported in Tchintabaraden and Abalak health districts in Tahoua region, including 28 deaths (Figure 16). This area is mainly populated by nomadic stockbreeders. Most of the cases were men (59.4%), of whom 79.2% were farmers or animal breeders.[1] The epidemic is ongoing.

Figure 17 shows when the human RVF cases were reported in Niger; Table 1 shows the breakdown by age and gender.

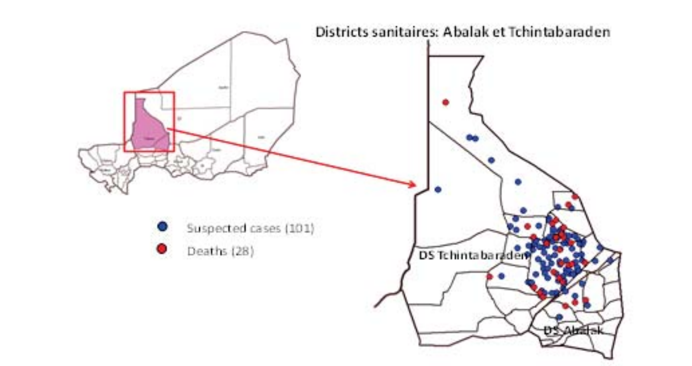
One RVF outbreak that affected cattle and small ruminants in Tansala village, Tchin Tabaren, Tahoua region was officially reported to OIE on 19 September 2016 (Figure 18). According to field investigations, four other villages reported increased mortality and abortion in animals. To date there has been no confirmed case reported in animals or humans in neighbouring countries.

Few data are available on any previous occurrence of RVF in Niger. A paper published in 1995[2] reported that RVF neutralizing antibodies were found in camels sampled between 1984 and 1988 in Agadez Department in northern Niger. Of the 141 animals tested, 67 (47.5%) were serologically positive. Another serological survey 557 sheep and 643 goats in 1986 indicated that 2.8% of the 1 200 animals tested had RVF virus-reacting antibodies.[3] This suggests that RVF virus has been circulating in Niger since the 1980s.

1 WHO. 2016. *Rapport de situation de la Fièvre de la Vallée de Rift, Niger*. Geneva.
2 Mariner, J.C., Morrill, J. & Ksiazek, T.G. 1995. Antibodies to hemorrhagic fever viruses in domestic livestock in Niger: Rift Valley fever and Crimean-Congo hemorrhagic fever. *Am J Trop Med Hyg*. 53(3): 217–21.
3 Akakpo, A.J.1, Saluzzo, J.F., Bada, R., Bornarel, P. & Sarradin, P. 1991. Epidemiology of Rift Valley fever in West Africa. 1. Serological investigation of small ruminants in Niger. *Bull Soc Pathol Exot*. 84(3): 217–24.

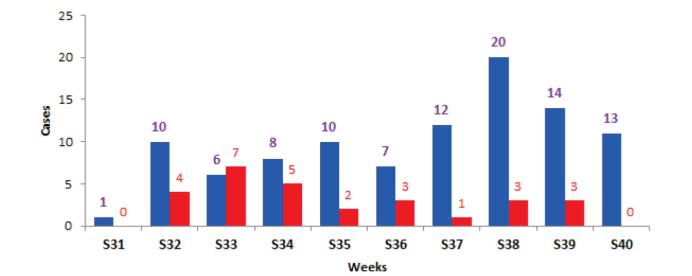
FIGURE 15. *Niger – political map*

FIGURE 16. *Human cases of suspected RVF in Niger*



Source: Reproduced with permission from WHO Regional Office for Africa (AFRO).

FIGURE 17. *Temporal distribution of human RVF cases in Niger*



Source: Reproduced with permission from WHO Regional Office for Africa (AFRO)

FIGURE 18. *Location of Niger's animal RVF outbreak*

Note: This outbreak was officially notified to OIE on 19 September 2016.

The security situation in the Sahel is considered unstable. In recent years this has hampered investigations and studies of RVF infection in the area (Figure 19).

Nomadic stockbreeders from Niger and neighbouring countries attended the annual *Cure Salée* festival from 23 to 25 September 2016, during which herds are brought to the city of Ingall in the central part of Niger, about 120 km west of Agadez, where they graze on the salty pastures of the Irazer plain before the dry season. About 2 million cattle and even more small ruminants are estimated to participate. At the end of the rainy season, following known migration patterns, the region's nomadic human population and their herds progress to other southern sub-Saharan countries where irrigation systems and pastures along the Niger river may still be available. The ongoing RVF outbreak, and the high concentration of animals in the area and likely transhumance patterns significantly increase the risk of transboundary spread of the disease (see map in Figure 20).

A significant number of live ruminants are exported from Niger to neighbouring countries (Table 2).

A significant number of small ruminants, cattle and camels are reared in the Sahel region (Figure 21). For human demographic data on Niger, see Figure 22. Table 3 shows the estimated number of livestock in Niger.

Preliminary analysis of satellite-derived normalized difference vegetation index time-series data recorded between 2000 and

TABLE 1 *Reported human RVF cases by age and sex*

Age	Sex F	Sex M	Total
0–4 years	0	1	1
5–14 years	10	10	20
15 years and over	31	49	80
Total	**41**	**60**	**101**

Source: WHO.

FIGURE 19. *Countries where aid workers have been killed, kidnapped or injured, January 2015 to June 2016*

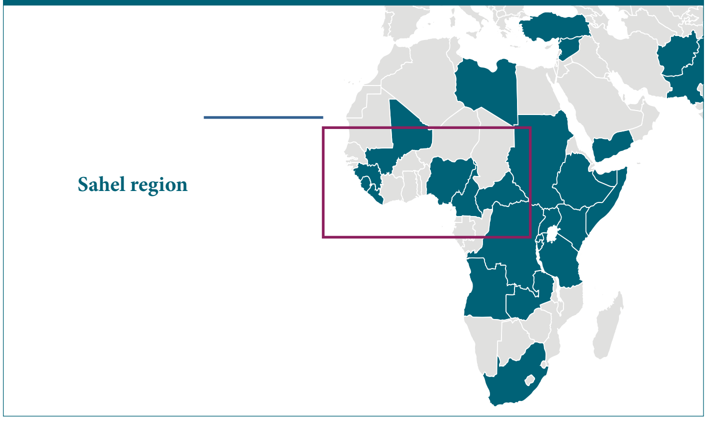
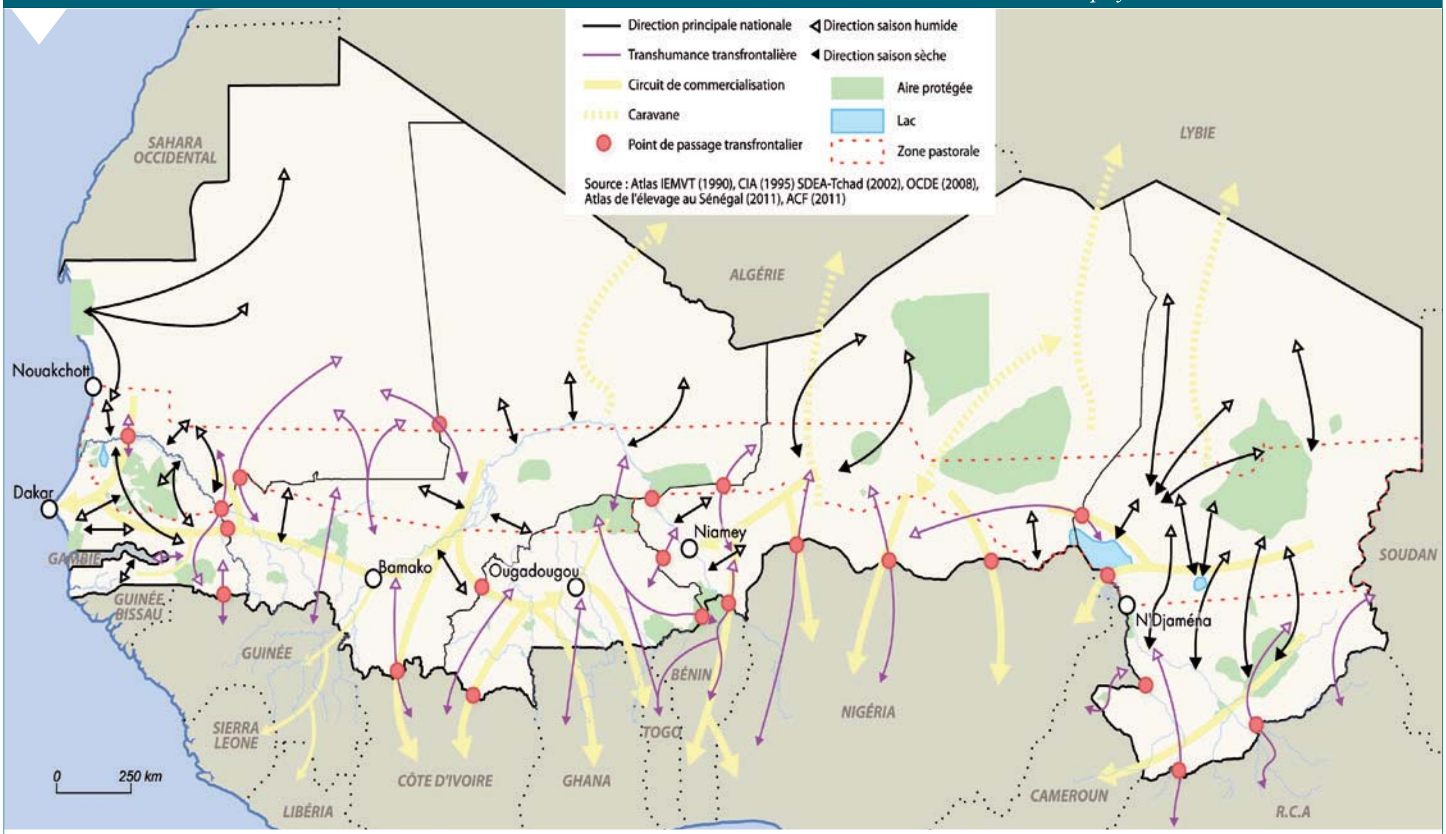


FIGURE 20. *Map of the main transhumant routes*



Source: FAO, CIRAD, 2012.

TABLE 2 *Estimated number of officially exported animals, by species and country of destination*

Countries	2006	2007	2008	2009	2010
Cattle	**99 826**	**79 324**	**115 179**	**151 254**	**216 205**
Algeria	…	…	…	…	…
Benin	305	…	230	…	15
Burkina Faso	25	…	…	…	…
Ivory Coast	40	8	…	…	…
Libya	…	…	…	…	…
Nigeria	99 429	79 306	114 836	151 226	215 940
Other countries	27	10	113	28	250
Sheep	**194 745**	**153 516**	**346 084**	**205 793**	**802 948**
Algeria	83	…	…	…	…
Benin	…	5	1 120	5 827	2 974
Burkina Faso	39	…	92	…	…
Ivory Coast	1 115	…	770	…	…
Libya	…	…	…	…	…
Nigeria	182 195	153 324	343 991	199 343	796 176
Other countries	1 1313	187	111	623	3 798
Goats	**353 989**	**340 434**	**399 981**	**343 237**	**582 034**
Algeria	…	…	…	…	…
Benin	2 677	…	425	262	1 328
Burkina Faso	…	…	…	…	…
Ivory Coast	…	…	…	…	…
Libya	…	…	…	…	…
Nigeria	351 067	340 434	398 758	342 886	580 189
Other countries	245	…	798	89	517
Camels	**184 003**	**8 108**	**18 133**	**19 506**	**26 316**
Algeria	52	…	…	…	…
Benin	…	…	…	…	…
Burkina Faso	…	…	…	…	…
Ivory Coast	…	…	…	…	…
Libya	13 176	202	526	15	723
Nigeria	170 774	7 906	17 606	19 456	25 229
Other countries	1	…	1	35	364

Source: STAT-Niger, 2012, data updated to 2010.

2016 for the area affected by RVF shows suitable environmental conditions for RVF vector amplification.

From January to mid-September 2016, the total precipitation in Tahoua region was 355 mm, about 80 mm more than the overall average (mean = 274 mm) for the area and the 16-year time period.

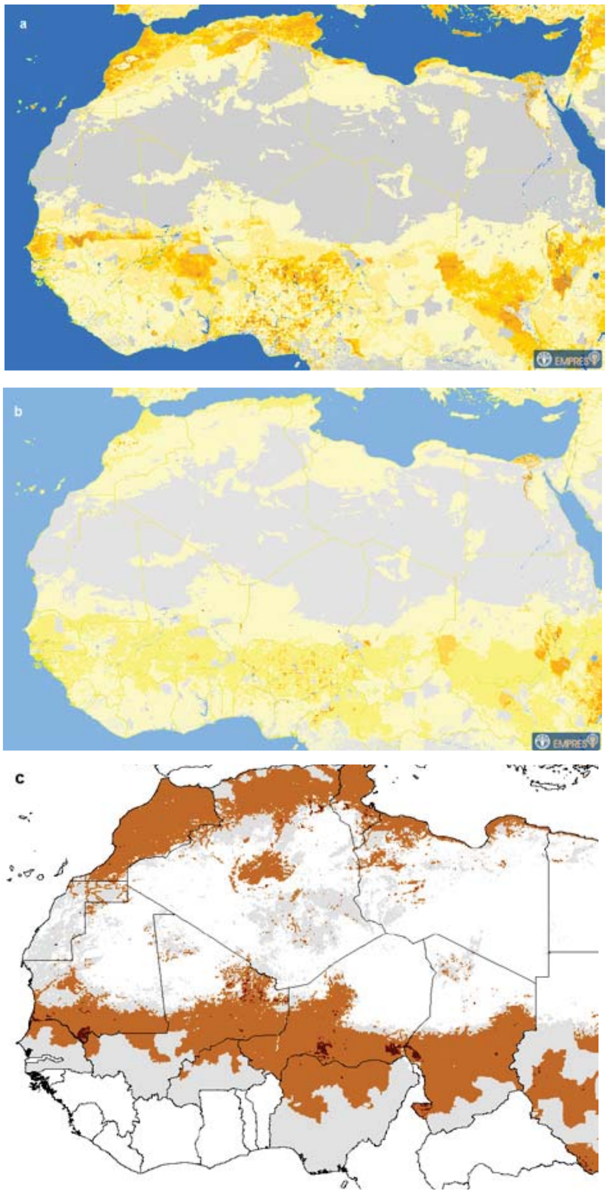
In 2016, peak in rainfall occurred in April – is usually a dry month – late May, July and late August. In mid-August precipitation was lower than average; June was also characterized by a dry spell. In semi-arid areas of Senegal and Mauritania, dry spells positively influence the dynamic of *Aedes* spp. by favouring the development of a second

TABLE 3 *Estimated livestock population in Niger*

Region	Cattle	Sheep	Goats	Camels	Donkeys	Horses
Agadez	24 552	408 274	672 609	143 429	90 632	273
Diffa	858 907	705 852	1 066 128	381 398	147 640	46 652
Dosso	930 383	753 145	993 441	29 334	136 618	16 438
Maradi	1 495 780	1 735 240	2 374 731	266 020	198 136	16 578
Tahoua	1 799 431	2 097 497	2 353 121	501 445	413 275	28 341
Tillaberi	1 969 372	1 360 426	1 651 805	89 048	300 084	18 849
Zinder	1 884 531	2 393 358	3 519 086	207 772	2 38 269	181 506
C.U. Niamey	49 884	164 806	91 614	45	2 727	288
Total	**9 012 840**	**9 618 598**	**12 722 535**	**1 618 490**	**1 527 381**	**308 925**

Source: Rapport annuel 2012 des statistiques de l'Elevage – MEL.

FIGURE 21. *Distribution of (a) small ruminants, (b) cattle and (c) camel in the Sahel region*



Source: FAO, 2005 – FAO 2016

FIGURE 22. *Niger – human demographic data*

Region	Area (Km²)	Population (2012 census)
Agadez	667 799	487 620
Diffa	156 906	593 821
Dosso	33 844	2 037 713
Maradi	41 796	3 402 094
Niamey	402	1 026 848
Tahoua	113 371	3 328 365
Tillabéri	97 251	2 722 842
Zinder	155 778	3 539 764

Source: CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=211663

population in the wet season. This coincides with the proliferation of *Culex* spp., increasing the risk of RVF in livestock (Figure 23). It is not known whether this pattern is relevant in Niger because no information is available on the vector species concerned nor on those involved in the current outbreak.

Similar weather conditions were observed in 1992, the last time RVF was detected in Niger (Figure 24).

Documents and guidelines are available from FAO[4,5] and WHO[6] outlining control measures in case of an RVF outbreak. A paper summarizing the main control approaches was published in 2014.[7]

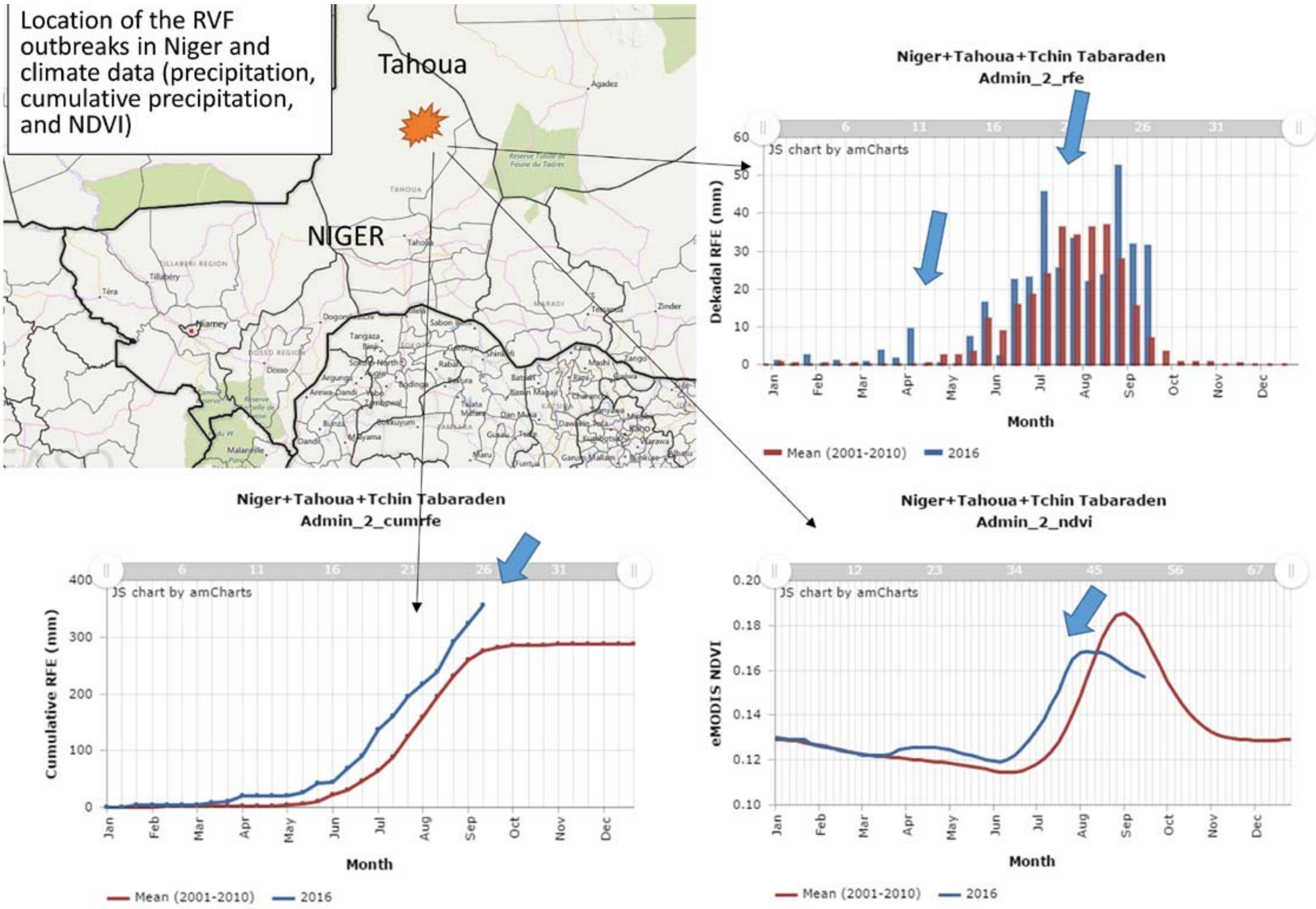
[4] FAO. 2003. *Recognizing Rift Valley Fever.* Available at www.fao.org/docrep/006/y4611e/y4611e00.htm

[5] FAO. 2002. *Preparation of Rift Valley Fever Contingency Plans.* Available at www.fao.org/docrep/005/y4140e/y4140e00.htm

[6] WHO. 2016. (Available at www.who.int/csr/disease/riftvalleyfev/en/). Accessed 12 December 2016.

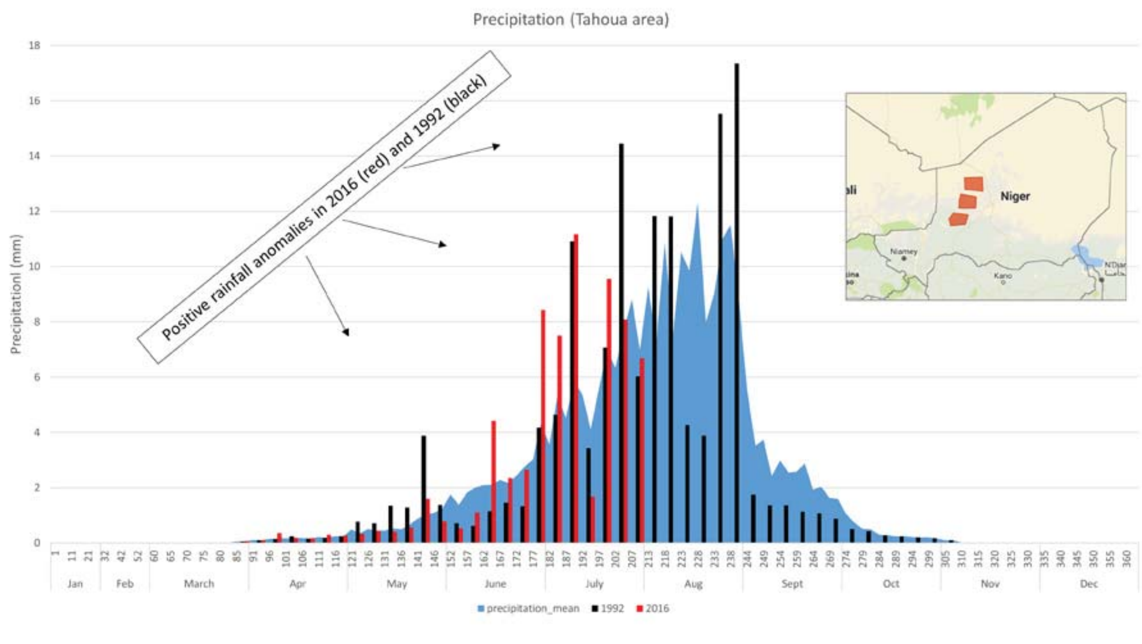
[7] de La Rocque, S. and Formenty, P. 2014. Applying the One Health principles: a trans-sectoral coordination framework for preventing and responding to Rift Valley fever outbreaks. *Rev. sci. tech. Off. int. Epiz., 2014, 33 (2), 555–567.* (Available at http://web.oie.int/boutique/extrait/16delarocque555567.pdf).

FIGURE 23. *Preliminary results analysing precipitation and NDVI recorded between 2000 and 2016 in the area affected by RVF*



Source: Reproduced with permission from USGS / FEWS NET; eMODIS NDVI (NASA); ,RFE (NOAA Climate Prediction Center)

FIGURE 24. *Comparison of precipitation trends in 1992 and 2016 for the Tahoua area*



Annex 2
ASSESSMENT METHODOLOGY

Risk questions

In view of increasing concerns about the ongoing RVF outbreak in Niger, the following questions should be urgently addressed:

1. What are the expected / potential consequences for public and animal health in Niger in the coming months, in the event that no effective control measures are put in place?
2. What is the risk of the RVF outbreak spreading in the coming months to Benin, Burkina Faso, Mali or Nigeria?
3. In view of the repeated outbreaks of RVF in recent years in other West African countries, what is the risk of RVF virus infection spreading to Algeria, Libya or Morocco in the next 3–5 years?
4. What risk factors affect the occurrence, persistence and spread of RVF infection in West Africa?
5. What control measures could be put in place to reduce the risk of RVF virus infection in West Africa?

Sub-questions

1. What are the expected / potential consequences for public and animal health in Niger in the coming months, in the event that no effective control measures are put in place?

   a. What is the risk of human RVF cases (assuming a 100% detection of human cases by the current surveillance and notification system) during this outbreak in Niger?
   b. What are the expected impacts on animal health and production of this RVF outbreak in Niger?

2. What is the risk of the RVF outbreak spreading, in the coming months, into the neighbouring countries of of Benin, Burkina Faso, Mali or Nigeria?

   a. What is the risk of having one or more RVF case in humans / animals in Benin, Mali, Burkina Faso, Mali or Nigeria during this vector season?

3. In view of the repeated outbreaks of RVF in recent years in other West African countries, what is the risk of RVF virus infection spreading Algeria, Libya or Morocco in the next 3–5 years?

   a. What is the risk of RVF virus spreading into Algeria, or Libya or Morocco during the next 3–5 years?
   b. What is the risk of the RVF virus persisting and spreading once introduced into Algeria, Libya or Morocco during the next 3–5 years?

4. What risk factors play a significant role in the occurrence, persistence and spread of the RVF infection in West Africa?

   a. Please rank from most to least relevant the risk factors and drivers for the (re)occurrence of RVF infection in West African countries and areas with a history of RVF infection or outbreak.
   b. Please rank from most to least relevant the risk factors and drivers for the spread of RVF infection into new areas of West Africa.

The following risk factors and drivers were submitted for expert evaluation: bioterrorism, technological under-development, social and economic instability, changing host susceptibility, changing ecosystems, climate and weather changes, microbial adaptation, animal movements, and trade and international travel.

5. What control measures could be put in place to reduce the risk of RVF virus infection in West Africa?

   a. Please rank from most to least feasible and effective measures to increasing the rapidity of response to RVF infection.
   The following control measures were considered: improving veterinary diagnostic laboratories, increasing veterinary capacity to recognize clinical signs of RVF in animals, improving public health diagnostic laboratories, enhancing medical capacity to recognize clinical signs of RVF in humans, developing risk assessment forecasting models, developing early-warning surveillance systems based on regular animal testing such as sentinels and cross-sectional testing.
   b. Please rank from most to least feasible and from most to least effective the prevention and control options for reducing the impact of a possible RVF incursion.
   The following preventive and control options were considered: culling sick and infected animals, eliminating insects and controlling mosquitoes, animal mass vaccination, vaccination of infected flocks/herds only, partial stamping out – culling of sick animals and vaccination of the remainder – public communication campaigns on measures to reduce exposure to mosquito bites, and communication campaigns for farmers and other professionals to reduce the risk of animal-sourced infections.

For each sub-question a standard grid was used to gather responses from the experts.

For sub-questions related to question 1, a risk matrix was used to take into account seven different levels of probability and five ranges of possible consequences (Table 4). The final levels of risk were calculated by summing the likely risk and consequence scores, giving 11 different final risk scores, which

TABLE 4 *Risk matrix used to gather experts' responses for question*

	0 Extremely unlikely 0%–1% Chance	1 Very unlikely 1%–10% Chance	2 Unlikely 10%–30% Chance	3 As likely as not 33%–66% Chance	4 Likely 66%–90% Chance	5 Very likely 90%–99% Chance	6 Extremely likely 99%–100% Chance
0 Low	0	1	2	3	4	5	6
1 Minor	1	2	3	4	5	6	7
2 Moderate	2	3	4	5	6	7	8
3 Major	3	4	5	6	7	8	9
4 Catastrophic	4	5	6	7	8	9	10

can be grouped into three levels: 0–3 = low; 4–6 = medium; and 7–10 = high (Table 4).

The experts were asked to give maximum and minimum estimates to enable analysis of the levels of uncertainty affecting these estimations.

A simplified probability matrix that considers the likely risk levels only was used to gather responses to sub-questions related to questions 2 and 3.

For sub-questions related to questions 4 and 5, tables with five ranking levels were used.

An online form was created to gather responses from the experts.

RISK ANALYSIS IN ANIMAL HEALTH

Risk analysis is a procedure, which we all do intuitively in our everyday life as we also do in our professional work to assess the risk of any hazard or threat. In animal health, risk analysis has been most widely used as a decision tool about the most appropriate health interventions to support disease control strategies, guide disease surveillance and support of disease control or eradication strategies.

It should be remembered that risk is not equal to zero and never stays static. Risks changes as drivers or factors of disease emergence, spread or persistence change such as intensification of livestock production, climate change, civil unrest and changes in international trading patterns. Risk analysis should therefore not be seen as a "one off" activity and it should be seen as a good practice of animal health systems to conduct their regular activities. Therefore, risk analysis process should be repeated and updated regularly.

Risk analysis comprises the following components:

H **Hazard identification:** the main threats are identified and described.

A **Risk Assessment:** risks of an event occurring and developing in particular ways are first identified and described. The likelihood of those risks occurring is then estimated. The potential consequences or impact of the risks if they occur are also evaluated and are used to complete the assessment of the risk.

M **Risk Management:** involves identifying and implementing measures to reduce identified risks and their consequences. Risk never can be completely eliminated but can be effectively mitigated. The aim is to adopt procedures that will reduce the level of risk to what is deemed to be an acceptable level.

C **Risk Communication:** an integrated processes that involves and informs all stakeholders within the risk analysis process and allows for interactive exchange of information and opinions concerning risk. It assists in the development of a transparent and credible decision-making processes and can instil confidence in risk management decisions.

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