Food and Agriculture Organization of the United Nations

Risk of foot-and-mouth disease SAT2 introduction and spread in countries in the Near East and West Eurasia

FAO QUALITATIVE RISK ASSESSMENT

OCTOBER 2023

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Rome, 2023

Required citation:

McLaws, M., Ahmadi, B.V., Condoleo, R., Limon, G., Kamata, A., Arshed, M., Rozstalnyy, A., Rosso, F. & Dhingra, M. 2023. *Risk of foot-and-mouth disease SAT2 introduction and spread in countries in the Near East and west Eurasia – FAO Qualitative Risk Assessment, October 2023*. Rome, FAO. https://doi.org/10.4060/cc8173en

ISBN 978-92-5-138263-9

Contents

Figures

Tables

Acknowledgements

The authors would like to thank the following external experts for their valuable contributions and feedback to the risk assessment:

- Donald King, Head of the World Reference Laboratory for Foot-and-Mouth Disease
- Eyal Klement, Professor, Koret School of Veterinary Medicine, The Robert H. Smith Faculty of Agriculture, Food and Environment, The Hebrew University
- Manuel Sanchez-Vazquez, Pan American Center for Foot-and-Mouth Disease and Veterinary Public Health (PANAFTOSA/VPH)
- Sergei Khomenko

Further thanks are given to the following FAO reviewers:

- Eran Raizman, Senior Animal Health and Production Officer, Regional Office for Europe and Central Asia
- Mario Zappacosta, Senior Economist and Team Leader, Global Information and Early Warning System (GIEWS), Markets and Trade Division (EST)

The authors also gratefully acknowledge the support of the FAO Regional Office for Europe and Central Asia, and the FAO Subregional Office for the Gulf Cooperation Council states and Yemen, for their coordination with national veterinary services to gather inputs to the questionnaires.

Abbreviations

EMPRES-i	Emergency Prevention System Global Animal Disease Information System
EuFMD	European Commission for the Control of Foot-and-Mouth Disease
ESS	FAO Statistics Division
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
FMD	foot-and-mouth disease
FMDV	foot-and-mouth disease virus
GFSI	Global Food Security Index
GLW	Gridded Livestock of the World
POAO	products of animal origin
WAHIS	World Animal Health Information System
WOAH	World Organisation for Animal Health
WRLFMD	World Reference Laboratory for Foot-and-Mouth Disease

Summary

Foot-and-mouth disease (FMD) is a highly contagious viral disease affecting cattle, sheep, goats, pigs and other cloven-hoofed animals. Although not a threat to human health, FMD severely impacts food security, livelihoods, and national and international markets. There are seven foot-and-mouth disease virus (FMDV) serotypes, and immunity is serotype-specific and will not provide protection against the other serotypes.

In February 2023, serotype SAT2 was detected in Iraq and Jordan, and subsequently in Türkiye and Oman. It is possible that SAT2 is present in other countries in the region but not yet detected or reported.

Serotype SAT2 usually circulates only in Africa, and so most animals in west Eurasia and the Near East are fully susceptible to infection by this virus. This risk assessment considers the likelihood of further spread to unaffected countries in the region via key risk pathways, and the potential consequences of the SAT2 incursion.

The assessment identified plausible pathways for a SAT2 incursion for most countries in the region. Informal movements of live animals and common grazing are the pathways of greatest concern because direct live animal contact is a very effective mode of FMD transmission, especially in the absence of sanitary measures. The large increase of animal movements associated with festivals such as Eid al-Adha (*qurban*), as well as seasonal grazing movements, increase the probability of FMD spread.

The other pathways analysed were assessed to have a lower likelihood of SAT2 introduction and spread. Cross-border spread of FMD via animal products is usually associated with pigs consuming contaminated products. However, many countries in the region have limited or no domestic pig populations, and wild boars are present in only some of the target countries. The other pathways (cross-border movements of wildlife, fodder, vehicles and people) are also possible in some countries, but each requires several events to complete the pathway. Furthermore, FMD transmission via indirect contact (fomites) is less effective compared to direct contact between infected and susceptible animals. Notably, objective and reliable data are lacking for many parameters, and therefore there is a high level of uncertainty around many of the likelihood estimates.

An incursion of FMD SAT2 would have a substantial negative impact in all countries considered in this risk assessment, with the production losses and cost of control measures estimated at USD 3.6–6.5 billion, depending on the extent of spread within the region. Outbreaks of FMD also have a negative impact on food and nutrition security, economy, labour markets, and the livelihoods of most vulnerable people. Several countries in the region are vulnerable to food insecurity, and outbreaks of FMD SAT2 would be expected to worsen this situation as the livestock populations are fully susceptible.

To mitigate the risks of FMD SAT2, all countries should have an emergency response plan for FMD that details how to manage a sudden increase in cases, such as would be expected with the introduction of a novel serotype such as SAT2. The response plan needs to be realistic for the country and supported with adequate resources for implementation when needed, and ideally should be tested through regular and realistic simulation exercises. Such an emergency plan may be stand-alone, or a part of a strategy for controlling or eradicating endemic FMD. A comprehensive list of preventive measures, including strengthened biosecurity and vaccination, is available in this document.

Background

Epidemiological situation in the region

Foot-and-mouth disease (FMD) is a highly contagious viral disease affecting cattle, sheep, goats, pigs and other cloven-hoofed animals. Although not a threat to human health, FMD severely impacts food security, livelihoods, and national and international markets. There are seven foot-and-mouth disease virus (FMDV) serotypes (A, O, C, SAT1, SAT2, SAT3 and Asia1). Immunity from infection or vaccination is serotype-specific and will not provide protection against the other serotypes. Seven endemic pools of FMD have been defined, which represent regions where specific FMDV lineages are maintained.

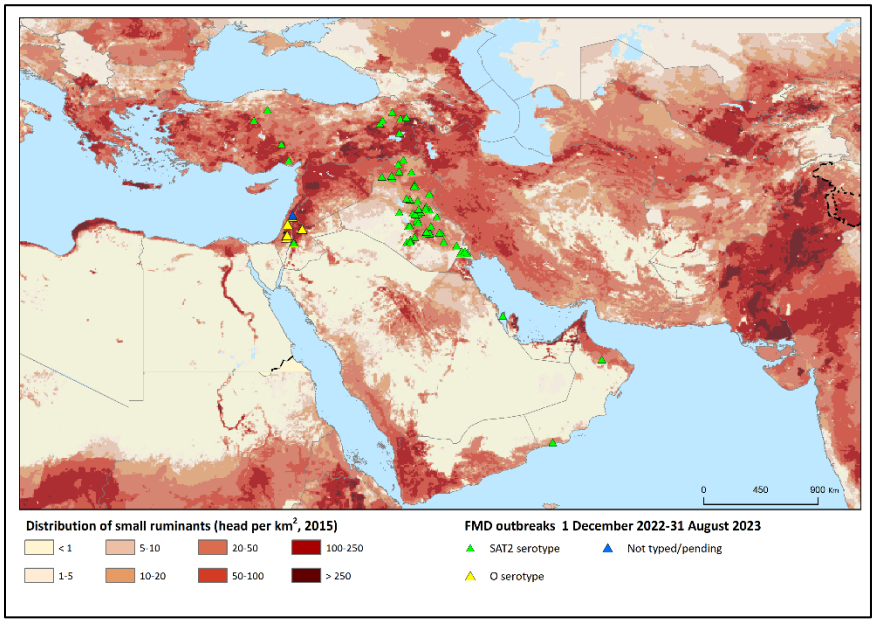
Countries in the Near East and west Eurasia are in FMDV pool 3, in which serotypes O, A and Asia 1 usually circulate. There is a high density of small ruminants the region and moderate density of large ruminants (Figure 1). The density of domestic pigs is very low in the region, with many countries reporting a total absence of pig farming (Annex A). However, wild boars are present in several countries. As omnivores, pigs may ingest contaminated products of animal origin (POAO) and become infected with FMD, which can be an important pathway for long-distance FMD spread.

On 3 February 2023, Iraq reported to the World Organisation for Animal Health (WOAH) that the SAT2 serotype was responsible for a surge of outbreaks reported in that country.[1] This report was followed by further reports in Jordan (confirmed on 2 February 2023, reported to WOAH on 16 February),[2] Türkiye (confirmed on 8 March 2023, reported to WOAH on 10 March),[3] Oman (sequences from the Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail [ANSES], Central Laboratory of Animal Health [Oman] and Sultan Qaboos University [Oman] 29 April 2023) and, by the end of June, Bahrain (World Reference Laboratory for Foot-and-Mouth Disease [WRLFMD], European Commission for the Control of Foot-and-Mouth Disease [EuFMD] and WOAH/FAO Reference Laboratory Network for Foot-and-Mouth Disease, 2023). Serotype SAT2 usually circulates only in Africa, and so most animals in west Eurasia and the Near East are fully susceptible to infection by this virus. Further characterization revealed that the causative virus in all countries is SAT2 topotype XIV, most closely related to SAT2 strains from samples collected in Ethiopia in 2022.

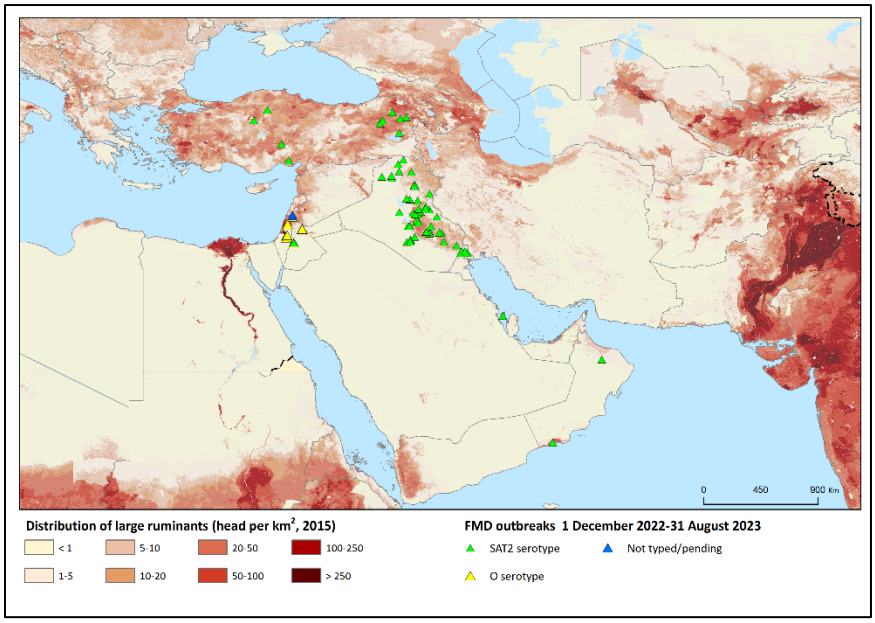
[1] See https://wahis.woah.org/#/in-review/4856?reportId=159145&fromPage=event-dashboard-url.
[2] See https://wahis.woah.org/#/in-review/4906?reportId=159353&fromPage=event-dashboard-url.
[3] See https://wahis.woah.org/#/in-review/4959?reportId=159769&fromPage=event-dashboard-url.

Figure 1. FMD outbreaks reported in the Near East and west Eurasia between 1 December 2022 and 20 August 2023

A



B



Note: Small ruminant (A) and large ruminant (B) density layers adjusted according to Food and Agriculture Organization Corporate Statistical Database (FAOSTAT) 2015 (Gridded Livestock of the World [GLW] 4).

Source: United Nations Geospatial. 2020. Map of the World. In: *United Nations*. New York. [Cited 21 September 2023]. https://www.un.org/geospatial/file/3420/download?token=TUP4yDmF. Modified with GLW 4 data and Emergency Prevention System Global Animal Disease Information System (EMPRES-i) data, 2022–2023.

Transmission of FMDV

Transmission of FMDV is via the respiratory or oral route. Infected animals shed FMDV in all secretions (saliva, urine, faeces, milk). FMD commonly spreads by animal movements, but can also be spread by contaminated clothing, footwear, equipment and vehicles. FMDV can survive for several weeks or even months in the environment and POAO, depending on environmental factors such as temperature, pH and humidity (Alexandersen *et al*., 2003). Under certain weather conditions, long-range airborne transmission may occur. This is especially relevant when pigs are infected, because they excrete large quantities of FMDV in their breath. Compared to pigs, ruminants excrete less FMDV in their breath, but are much more susceptible to infection by the respiratory route (Alexandersen *et al*., 2003).

Risk assessment scope

Countries and territories included in this rapid risk assessment (i.e. target countries) are those with a contiguous land border with affected countries detected as of 20 August 2023, namely Armenia, Azerbaijan, Bahrain, Bulgaria, Cyprus, Georgia, Greece, the Islamic Republic of Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, the Syrian Arab Republic , Türkiye, the West Bank in Palestine, the United Arab Emirates and Yemen.

Risk questions and risk pathways

The following risk questions were considered:

1. What is the likelihood of FMD-susceptible livestock in unaffected countries being exposed to FMD serotype SAT2 due to its introduction from affected countries via the following pathways:
    a. movement of live animals between countries (including legal and informal trade, and common grazing)?
    b. legal and informal trade in POAO (meat and milk of FMD-susceptible animals)?
    c. movement of wildlife between countries?
    d. movement of people between countries?
    e. trade in fodder?
    f. movements of vehicles between countries?

These pathways were identified based on the epidemiology of FMD, as well as previously identified routes of transboundary spread (McLaws and Ribble, 2007). Other potential pathways, such as trade in manure or long-range airborne spread, were not included due to lack of data and because of the very low density of pigs in the region, which are an important factor in airborne spread (see Transmission of FMDV section above).

2. What is the potential impact of FMD-susceptible livestock being exposed to FMD serotype SAT2:
    a. in unaffected countries?
    b. in countries already affected?

Methodology

For the likelihood component, the risk assessment considers information available up to 18 June 2023, and is based on the major risk pathways listed above. For each pathway the major steps are defined, and the overall likelihood assessed and assigned one of four levels (Table 1). Due to the conditional nature of the steps within a pathway (i.e. the next step does not occur unless the previous one is fulfilled), the overall likelihood of each pathway will be that of the least likely step.

Table 1. Likelihood definitions used in assessment

Likelihood of event occurring	Descriptive definition
Negligible	The likelihood of the event is virtually zero; it may only occur in exceptional circumstances.
Low	The event is unlikely; it may occur in a few cases.
Moderate	The event is likely; it may occur in some cases.
High	The event is very likely; it can be expected to occur frequently.

Source: Adapted from **FAO.** 2021. *Technical guidelines on rapid risk assessment for animal health threats*. FAO Animal Production and Health Guidelines No. 24. Rome. https://doi.org/10.4060/cb3187en

Additionally, the level of uncertainty was assessed based on the quantity and quality of the data available for the assessment (Table 2).

Table 2. Definitions for the levels of uncertainty used

Level	Description
Low	Available information and data are relevant to the risk assessment, consistent and not conflicting. No subjective judgment is introduced. Published data can be used.
Moderate	Some information and data are lacking, incomplete, inconsistent or conflicting. Subjective judgment with supporting evidence is introduced. Published data can sometimes be used.
High	Most information and data are lacking, incomplete, inconsistent or conflicting. Subjective judgment may be introduced without supporting evidence. Unpublished data are frequently used.

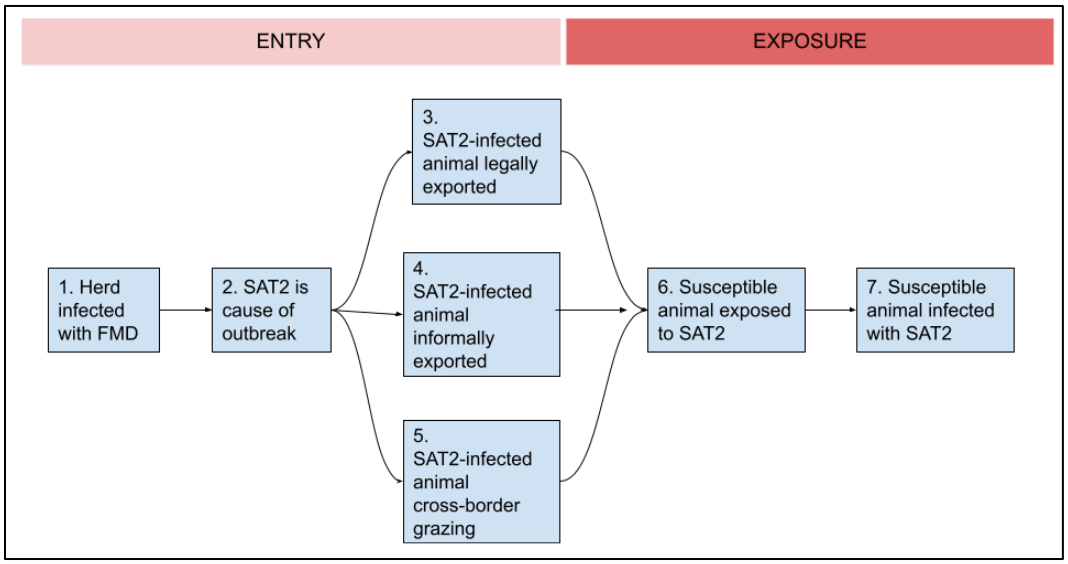
Source: Adapted from **FAO.** 2021. *Technical guidelines on rapid risk assessment for animal health threats*. FAO Animal Production and Health Guidelines No. 24. Rome. https://doi.org/10.4060/cb3187en

A questionnaire addressing relevant risk factors was distributed in April 2023 to the official veterinary services in the 21 target countries (Annex A and Annex B). A total of 15 responses to the questionnaire were received (71 percent response rate) and collated in a spreadsheet for analysis. Data from the literature, FAOSTAT and other secondary sources supplemented the information received from the questionnaire.

Results

Movement of live animals between countries (including legal and informal trade, and common grazing)

Figure 2. Live animal movement risk pathway



Source: Authors' elaboration.

Likelihood of infection with FMD and serotype SAT2 (Figure 2, boxes 1 and 2)

FMD is endemic in most of the target countries. The most westerly provinces of Türkiye (Thrace region) are officially recognized as FMD-free with vaccination, and Bulgaria, Cyprus and Greece are officially FMD-free without vaccination. In endemic areas, the incidence of FMD fluctuates over time, believed in part to be due to the emergence of new FMDV variants for which the population may have less immunity from either vaccination or infection. The reported prevalence of antibodies to non-structural proteins to FMDV, indicating prior infection, ranges widely, from less than 2 percent to over 50 percent (Knight-Jones *et al.*, 2017).

Until late 2022, FMD serotype SAT2 was not present in the target countries. Since then, it has been reported in five countries (Bahrain, Iraq, Jordan, Oman, and Türkiye). It is possible that SAT2 could be present in other countries in the region; as the clinical presentation of SAT2 is indistinguishable from infection with other serotypes, it may not have been detected or reported. In Jordan, SAT2 was isolated from samples received from two governorates (Mafraq and Zarqa) which are located near to the borders with Saudi Arabia and Syria. The SAT2 outbreaks in Iraq and Türkiye are more widespread, with those in Iraq mostly reported in the eastern part of the country and involving both large and small ruminants (WOAH, 2023). In Türkiye, outbreaks have been reported in central and eastern Anatolia. Aside from the WRLFMD results, there is no further information regarding the outbreaks in Oman.

Apart from Kuwait and the United Arab Emirates, which include SAT2 in their prophylactic vaccination (FAO, 2023a), the FMD vaccine used in most countries in region did not include any SAT2 serotype lineage prior to this incursion. Thus, the vast majority of the livestock population would have been fully susceptible to infection with SAT2 with the potential for rapid spread. Since SAT2/XIV was detected, SAT2-specific vaccines

have been applied in Armenia, Georgia, Israel, Jordan and Türkiye. Of the known recently affected countries, there has been no SAT2 vaccination in Iraq.

Legal live animal trade (Figure 2, box 3)

In the questionnaire survey, two countries (Azerbaijan and the United Arab Emirates) reported legal imports of animals from affected countries (Türkiye and Jordan, respectively) since December 2022. According to trade data available from FAOSTAT, several countries (Bahrain, Bulgaria, Georgia, the Islamic Republic of Iran, Kuwait, Lebanon, Qatar, Saudi Arabia, the Syrian Arab Republic, the United Arab Emirates and Yemen) imported live animals from countries affected with SAT2 in 2020 and/or 2021 (most current data available). All but three countries/territories imported animals from other countries in the region in 2020/2021.

Many countries follow the recommendations within the WOAH Terrestrial Animal Health Code regarding sanitary measures to mitigate trade-related risks of FMDV introduction. In all target countries, animals are subject to a minimum of health checks as part of import procedures (FAO, 2023a). In countries where SAT2 has been detected, severe clinical signs have been reported in large and small ruminants, which may be in part attributed to the lack of immunity. Therefore, clinical signs are likely to be detected in animals undergoing clinical inspection as part of periodical health checks. However, as with other FMD serotypes, a significant proportion of small ruminants may be subclinically infected or only exhibit mild clinical signs, which may not be reported or readily detected during a health check.

Many countries also quarantine and perform FMD testing at or prior to entry. If properly implemented, these procedures should be quite effective to prevent the entry of an FMD-infected animal. However, the level of compliance with these procedures is often uncertain.

Informal live animal trade (Figure 2, box 4)

Informal trade of live animals often occurs between countries, particularly if there is a market price differential that acts as a driver. In other situations, large livestock markets are conveniently located near the border. The Syrian Arab Republic reported that informal live animal trade occurs occasionally with Iraq, while the United Arab Emirates reported this type of trade with several countries, including Jordan, and especially in the period around Eid al-Adha (FAO, 2023a). Such movements also occur between Iraq, the Islamic Republic of Iran and Türkiye. Informal trade is an important pathway for the spread of transboundary animal diseases because no health checks or measures are enforced to prevent an infected animal being traded. Indeed, in some cases, livestock owners may be motivated to sell infected animals as soon as they notice signs of illness, to minimize their financial loss.

Common grazing (Figure 2, box 5)

Common grazing refers to the use of pasture lands by different livestock owners. It is an opportunity for animals from different origins to mingle and potentially transmit diseases including FMD. Common grazing may take place close to a permanent residence for livestock (for example on lands near a village) or involve a long-distance movement to reach pastureland (transhumance). Such movements are often seasonal and may be within a single country or across national borders.

Survey respondents indicated that common grazing is practised in most countries. Yemen indicated that cross-border grazing is practised with Oman and Saudi Arabia. No other countries reported cross-border grazing with countries where the SAT2 serotype is known to be circulating at the time of writing. However, previous studies indicated that there was cross-border grazing between Georgia and Türkiye, Iraq and

Türkiye, and Iraq and the Islamic Republic of Iran (Di Nardo *et al*., 2011). SAT2 outbreaks in Türkiye have been detected near the Georgian border, as well as near the Iraqi-Iranian border (Figure 1). Should SAT2 enter other countries, notably the Islamic Republic of Iran and the Syrian Arab Republic, common grazing could be an important spread pathway unless preventive measures are taken, such as vaccinating grazing animals for protection against the SAT2 serotype. Of particular attention, reported in previous studies, is the Syrian desert (including parts of western Iraq, eastern Jordan, northern Saudi Arabia and southern Syrian Arab Republic) where pastoralist tribes from Iraq, Jordan, Saudi Arabia and the Syrian Arab Republic and move their animals to the northern and eastern regions for grazing (seasonal migration). It is mainly sheep and goats which are involved in seasonal migration, which is dependent on the availability of grass, water and crop residues. Movement and mix of potentially millions of sheep and goats to this region for grazing following the winter rains may pose a substantial risk of transmission of FMD and peste de petits ruminants.

Exposure of susceptible animals in unaffected country (Figure 2, box 6)

Once animals have been imported to a country, they may be sold to farmers, sent to a live animal market or taken directly to slaughter. The proportion of animals sent to each destination varies by country. However, in all analysed countries, it is likely that imported animals may be in contact with susceptible animals in the destination country. For common grazing, this exposure is implicit.

FMD transmission from infected to susceptible animals (Figure 2, box 7)

FMD is highly contagious, and susceptible ruminants can be infected by very low doses of inhaled FMDV through direct contact with the breath of other acutely infected animals. Compared to ruminants, pigs require a higher infectious dose via inhalation routes, but are more susceptible to infection via the oral route (Paton *et al*., 2018).

At the time of writing, vaccination against SAT2 is implemented in Armenia, Georgia, Israel, Jordan, Kuwait (dairy animals), Türkiye and United Arab Emirates. A protective immune response to SAT2 vaccine will depend on many factors, including the quality and potency of the vaccine used, the design and implementation of the vaccination strategy, and the time required to build population immunity. Any weakness in those elements would lead to insufficient level of protection in the population. Susceptible species in other countries will not have immunity to SAT2 from either vaccination or infection. Therefore, it is highly likely that animals exposed to SAT2 via direct contact will become infected.

Summary

- The likelihood of spread of SAT2 to unaffected countries through **legal trade** in live animals is assessed as:
    - **Low** for **countries** that have imported live animals from affected countries since 2022.
        - This low likelihood is due to the control measures in place, as well as the relatively low volume of trade (Annex C). If the import sanitary measures are not strictly followed, the likelihood would be considered moderate.
        - Such trade was reported by Azerbaijan and the United Arab Emirates (FAO, 2023a). There is **moderate uncertainty**, as compliance with these sanitary measures is unknown.
        - For countries that did not respond to the questionnaire, trade data for 2020–2021 were used for the assessment. Bahrain, the Islamic Republic of Iran, Qatar and Saudi Arabia

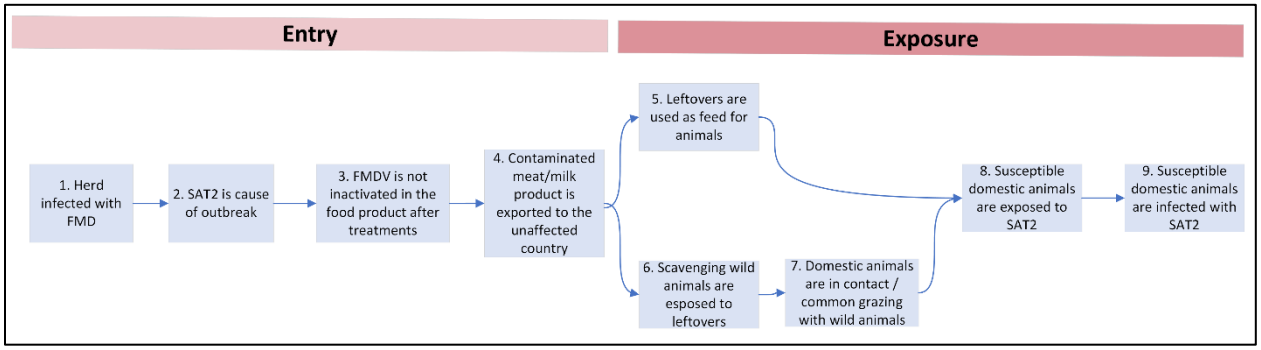
traded live animals with countries where SAT2 has been detected. There is **high uncertainty** related to this assessment, as the trade data pertain to a period prior to the detection of SAT2 in the region.

- **Negligible** for countries that have not imported animals from affected countries since December 2022, with **moderate uncertainty** due to the potential for undisclosed spread of SAT2.

- The likelihood of spread of SAT2 to unaffected countries through **informal trade** in live animals is assessed as:
  - **High** for countries with informal trade with Iraq (reported by the Syrian Arab Republic) (FAO, 2023a).
    - The likelihood is considered high because of the lack of SAT2 vaccination in Iraq.
  - **Moderate** for countries with informal trade with Jordan and/or Anatolia, Türkiye (reported by Azerbaijan and the United Arab Emirates) (FAO, 2023a).
    - Jordan and Türkiye have undertaken vaccination campaigns for SAT2, so the likelihood is lower than for countries with a connection with Iraq.
  - **Low** for countries with informal trade with the Thrace region of Türkiye (reported by Bulgaria (FAO, 2023a).
    - Thrace is a zone recognized as FMD-free with vaccination.
  - **Negligible** for countries that do not have informal trade with affected countries since December 2022.
  - **Not assessed** for countries that did not respond to the questionnaire, due to lack of information.
  - In all cases, there is a **high uncertainty** due to a lack of data on informal trade, as well as the potential for undetected spread of SAT2.
- The likelihood of spread of SAT2 to unaffected countries through **common grazing** is assessed as:
  - **High** for the Islamic Republic of Iran, due to cross-border grazing with Iraq.
  - **High** for Yemen, due to cross-border grazing with Oman, with **high uncertainty** related to the extent of spread of SAT2 in Oman.
  - **Moderate** for Georgia, due to cross-border grazing with Türkiye.
    - There is a lower likelihood than the estimates for the Islamic Republic of Iran and Yemen, because Georgia and Türkiye have undertaken vaccination campaigns for SAT2.
  - **Negligible** for countries that do not practice common grazing with affected countries.
  - There is **high uncertainty** relating to a lack of objective and detailed information on the frequency and timing of the common grazing, the extent of contact between herds on pasture, and the potential for undetected spread of SAT2.

Legal and informal trade in POAO (meat and milk of FMD-susceptible animals)

Figure 3. Product of animal origin pathway



Source: Authors' elaboration.

Boxes 1, 2 and 9 are described in the live animal movement pathway.

FMDV inactivation (Figure 3, box 3)

Susceptible animals become viremic a few days after infection, and FMDV can potentially be present in any part of the carcass or organ during the viremia. FMDV can survive for several weeks or months in animal tissues or derived unprocessed food products (i.e. raw meat) depending on the environmental or storage conditions (Ryan *et al*., 2008). FMD is rapidly inactivated by changes in pH, as occurs in skeletal muscle during rigor mortis, as well as by heat treatment (cooking). Therefore, treatments applied to processed products usually ensure the destruction of FMDV. Viable FMDV may persist in bone marrow and lymph nodes, or in raw meat that is frozen immediately after slaughter. Pasteurization will result in a significant reduction of titre, but pasteurized milk may still contain infectious FMDV (Callis, 1996; Ryan, 2008).

Trade in products of animal origin (Figure 3, box 4)

Some countries have reported formal or informal import of meat and milk products from affected areas since December 2022 (FAO, 2023a). Specifically, Azerbaijan, Georgia and the United Arab Emirates have imported various food products of animal origin from Türkiye. However, in most cases, details were not provided about the specific type of product, nor whether imports were formal (legal) or informal.

Data extracted from the FAOSTAT database concerning trade in meat and milk products in 2020 and 2021 (FAO, 2023b) revealed that, in addition to the above-mentioned countries, Türkiye exported to Bahrain, the Islamic Republic of Iran, Israel, Jordan, Lebanon, Oman, Qatar, Saudi Arabia, the Syrian Arab Republic and Yemen. Jordan exported to Azerbaijan, Bahrain, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, the Syrian Arab Republic, the United Arab Emirates, the West Bank and Yemen. Iraq exported to Bahrain, Türkiye and the United Arab Emirates (Annex B). FAOSTAT commercial categories do not provide information regarding the different treatments applied to POAO, but based on the reported description, these countries mostly traded processed products, with some exceptions regarding small amounts of fresh meat (deboned or bone-in).

In case of legal trade, as with the live animal pathway, countries may follow the standards set out in the WOAH Terrestrial Animal Health Code to mitigate FMD trade risks. Most of the countries in the region require that POAO are accompanied with an FMD-free certificate issued by the country or territory of origin. Bulgaria, Cyprus and Greece do not ask for this certificate, as European Union regulations allow the

importation of POAO only from officially FMD-free areas. Georgia also does not ask for an FMD-free certificate (FAO, 2023a).

Many unaffected countries reported the export/introduction of POAO to the surrounding nations. There are trade connections between Armenia, Azerbaijan and Georgia, and possible introduction of POAO from these countries to the Islamic Republic of Iran, Iraq, Türkiye and some Gulf countries (Annex B) (FAO,2023a; FAO, 2023b).

Management of leftovers (Figure 3, box 5)

Meat and milk products from affected countries are mainly imported for human consumption. However, animals (particularly domestic pigs) may be fed with leftovers (i.e. swill-feeding), although this practice may be formally forbidden by national laws. It is difficult to estimate how common swill-feeding is in the different countries. Armenia and Georgia reported that swill-feeding is rare, whereas Greece reported it is quite common. Swill-feeding is reported to not to occur in the other countries, most of which have little to no pig farming (FAO, 2023a).

The role of wild boars (Figure 3, boxes 6 and 7)

Wild boars and/or scavenging pigs can play an important role in the spread of FMD because they can have access to food waste or landfill and thereby be exposed to contaminated materials. Wild boars exist in several target countries, although they are absent in Cyprus, Yemen and the Gulf countries (Figure 5). Wild boars' access to landfill was reported as common (Greece, Türkiye and the West Bank), rare (Armenia and Bulgaria) or impossible (Azerbaijan, Georgia and the Syrian Arab Republic) (Annex A). In Greece and Türkiye, the contact between wild boars and susceptible animals is considered common in only some areas, while this event is evaluated as rare in Armenia and Georgia, and unlikely in the other countries. Some countries declared that wild boars graze together with domestic ruminants or pigs commonly (Bulgaria, Greece and the West Bank) or occasionally (Azerbaijan and Türkiye).

Exposure to contaminated food products (Figure 3, box 8)

Transmission of FMD to pigs through the ingestion of contaminated food intended for human consumption has been proven (McLaws and Ribble, 2007; Hernández-Jover, 2016). However, susceptible animals need a much higher dose of FMDV by oral route than that required to get infected by the airborne route (Kitching and Alexandersen, 2002; Alexandersen, 2003). Moreover, FMDV is sensitive to a wide range of treatments that are applied during food manufacturing and domestic preparation, such as pasteurization, cooking, salting and curing (Ryan *et al*., 2007). Thus, survival of FMDV in treated food product is unlikely, and susceptible animals are likely to become infected only through the consumption of food subjected to an inadequate inactivation process (i.e. raw or undercooked). It is unknown how commonly swill is treated to effectively inactivate the FMDV.

Summary

- The likelihood of spread of SAT2 to unaffected countries through formal trade in POAO is assessed as:
    - Low for countries that have imported POAO from affected countries, as these are intended for human consumption, and most will be processed with a treatment that inactivates FMDV. This includes:

- Georgia, due to the reported trade with Türkiye, possible swill-feeding practices, and presence of wild boars that could favour the exposure to domestic animals. **Moderate uncertainty**, mainly due to lack of information regarding treatment applied to food products and the frequency of formal import.
- Azerbaijan, Israel, Lebanon, the Syrian Arab Republic and the West Bank, due to reported trade or import during the previous year of meat and milk products from affected countries. Although pig swill-feeding in these countries is unlikely, presence of wild boars and possible access to leftovers can favour spread of SAT2. High uncertainty because trade data referred to past years.

o **Negligible** for countries that:

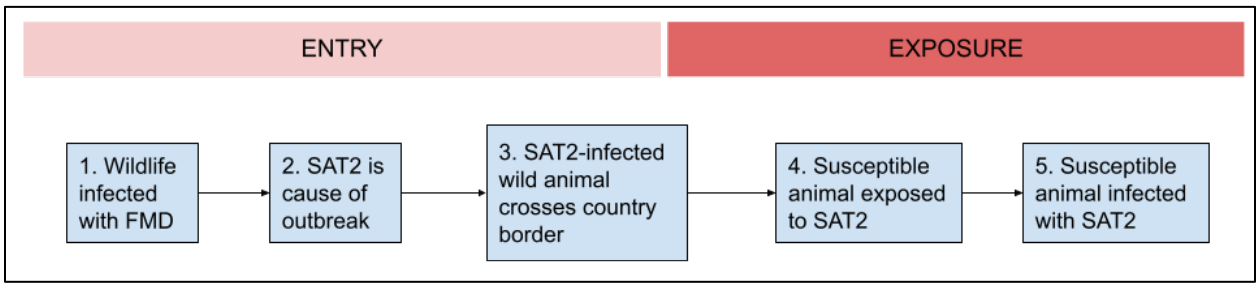
- do not trade with affected countries, and/or
- where swill-feeding is unlikely and wild boars do not play a role in spread of SAT2.
- **Moderate uncertainty** due to the possibility of undetected outbreaks in unaffected countries and potential role of susceptible species other than pigs.

o Assumptions: FAOSTAT meat and milk product categories for which manufacturing processes involve a significant heat treatment or change in pH (for example canned meat products) would inactivate FMDV, and were therefore not considered in the assessment.

The likelihood of spread of SAT2 to unaffected countries through **informal trade in POAO** cannot be assessed due to the lack of specific data. Because these products are not subject to official sanitary measures, it is assumed that the likelihood of SAT2 introduction through this pathway is equivalent or higher to that reported for the formal trade.

Movements of wildlife between countries

Figure 4. Wildlife pathway



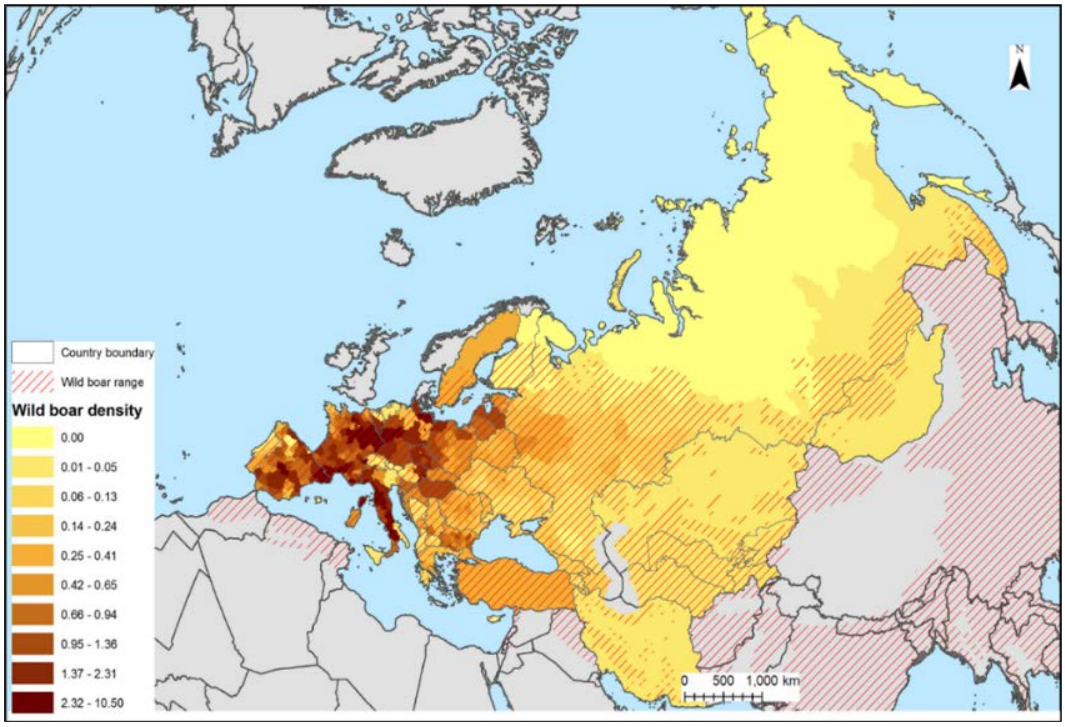
Source: Authors' elaboration.

Susceptibility of wildlife to FMD and SAT2 (Figure 4, boxes 1 and 2)

FMD mainly affects members of the order Artiodactyla (cloven-hooved mammals). Susceptible wildlife species in the Near East and west Eurasia include wild boars (Sus scrofa), wild sheep and goats, and several species of deer and antelope, such as the Arabian oryx and the mountain gazelles (Weaver *et al.*, 2013). While FMD has been reported in captive Arabian oryx, FMD has not been detected in wild populations (Weaver *et al.*, 2013). FMD has been detected in mountain gazelles (Elnekave *et al.*, 2016); however the population of these gazelles is small (estimated at around 5 000 individuals) and primarily restricted to Israel (Yom-Tov *et al.*, 2021). Wild boars are prevalent in several of the target countries (Figure 4).

An outbreak of FMD serotype O in Bulgaria in 2011 was first detected in wild boars (Valdazo-González *et al.*, 2012). Active surveillance found that 7 percent of 812 wild boars and 4 percent of 68 roe deer had antibodies against FMDV, but no viral RNA was detected (Alexandrov *et al.*, 2013). The epidemic was controlled through measures on livestock, without interventions on deer, wild boars or other wildlife. Hence, there is no empirical evidence to suggest that European wildlife can play a role in the maintenance of FMDV (European Food and Safety Authority, Panel on Animal Health and Welfare, 2012).

Figure 5. Wild boar density and range



Source: **Pittiglio, C., Khomenko, S. & Beltran-Alcrudo D.** 2018. Wild boar mapping using population-density statistics: From polygons to high resolution raster maps. *PLoS ONE*, 13(5): e0193295. https://doi.org/10.1371/journal.pone.0193295

There is a clear variation in the susceptibility to FMDV based on the host species and viral serotype involved (Weaver, 2013). The three SAT serotypes are endemic to sub-Saharan Africa and are adapted to their maintenance host, African buffalo. Although relatively rare, infection of pigs with SAT2 virus has been reported (Ehizibolo, 2016; Hailu 2017), as has the infection of various wild antelope species such as impala (Weaver, 2013). However, the susceptibility of wild boars and other wildlife in the region of interest to the SAT2 serotype is unknown.

As with livestock, wildlife may become infected with FMD through direct or indirect contact with an infected wild or domesticated animal. This can occur through sharing grazing pastures, common water sources, or ingestion of contaminated foodstuffs. Compared to cattle, pigs are less susceptible to aerosol infection and more susceptible to infection via the gastrointestinal route (Artz, 2011).

Cross-border movements of wildlife (Figure 4, box 3)

A detailed review of wildlife migration patterns in the region is beyond the scope of this assessment. The greatest threat is assumed to be associated with wild boars, due to their relative abundance, and because they are omnivores susceptible to infection through scavenging and ingesting contaminated foodstuffs. It

is known that the home range of wild boars is relatively limited, usually 4–8 km^2, although with important variations across geographic locations and habitats. Increased mobility occurs for males during the rutting season (late autumn and early winter), as well as postweaning for young wild boars (Podgórski and Śmietanka, 2018).

With some exceptions, wildlife can freely cross most national borders in the analysed region. Therefore, if a wild animal is infected with SAT2, they could then cross a national border and infect either wild or domestic susceptible animals on the other side of the border.

Transmission from wildlife to livestock (Figure 4, box 4)

Respondents from several countries indicated that wild boars might share grazing pastures with domestic animals (Armenia, Azerbaijan, Bulgaria, Georgia, Türkiye and the West Bank). This would suggest that the transmission from wild boars is possible, either through direct or indirect contact (i.e. contamination of grazing pastures with the excretions of infected animals).

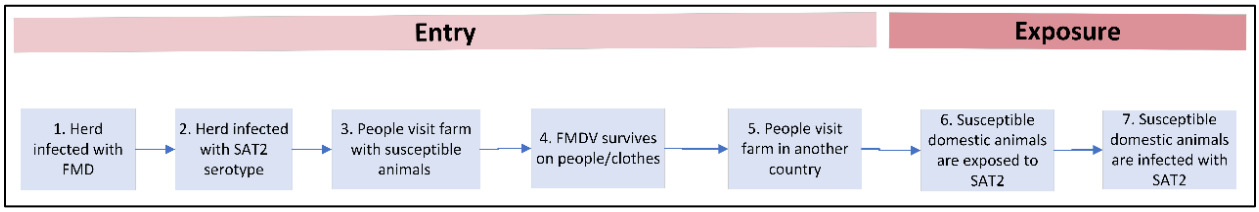
Summary

The likelihood of spread to unaffected countries via wildlife is:

- **Low** for countries with a border proximal to an affected area, populations of wild boars, and potential opportunities for direct or indirect contact with domestic livestock (Armenia, Georgia, the Islamic Republic of Iran, Israel, the Syrian Arab Republic and the West Bank).
    - The likelihood is low because while it is possible that wildlife will be infected with SAT2, cross a national border and subsequently infect domestic livestock, this is only expected to occur in a few cases.
- **Low to negligible** for countries which have wild boar populations but are not proximal to affected areas (Azerbaijan, Bulgaria, Greece and Lebanon).
- For the above points, there is **high uncertainty** related to the susceptibility of wildlife to SAT2 and the extent of contact between wildlife and domestic species, as well as the potential for undetected spread of SAT2 in wild and/or domestic animals.
- **Negligible** for countries that do not have populations of wild boars, with low uncertainty.

Movement of people between countries

Figure 6. Movement of people between countries pathway



Source: Authors' elaboration.

Boxes 1, 2, 6 and 7 are described in the movement of live animals between countries pathway.

People visiting farms (Figure 6, box 3)

FMD-infected animals shed significant amounts of FMDV through aerosols and other secretions and excretions (saliva, urine and faeces), and can therefore easily contaminate the environment. In fact, infected animals can excrete FMDV up to two days before symptoms manifest (Yadav *et al*., 2019).

Therefore, anyone who visits an infected farm could be exposed to FMDV, and their clothes, footwear or equipment could become contaminated with viable FMDV.

FMDV survival on clothes and other fomites (Figure 6, box 4)

It has been reported that FMDV can survive in certain fomites for up to 14 days, although this period can vary based on environmental conditions (Rossi *et al.*, 2016; Colenutt *et al.*, 2020). Thus, even though there are no dedicated studies, it is presumable that FMDV may remain infectious on clothes, shoes, equipment and farming tools for a few days in an area where SAT2 is circulating. The extent of the contamination is very difficult to quantify because it depends on numerous factors such as time, temperature, the mode of exposure to the infected animals or the herd environment as well as any biosecurity measures taken. After visiting a farm, people or workers may take biosecurity measures such as changing their clothes and footwear, and cleaning organic material from their boots and equipment. Such measures can reduce the probability of further spread of FMDV, either within the country or to another country.

People visiting farms in another country (Figure 6, box 5)

Farm workers, veterinarians and animal owners are examples of people who could cross borders wearing or bringing contaminated clothes or other fomites that may subsequently be a source of infection for domestic animals in the destination country. Based on data from the questionnaires (FAO, 2023a), visitors or workers from other countries often visit local farms in some countries. This is considered frequent in the Syrian Arab Republic (with people visiting from Jordan, Iraq, the Islamic Republic of Iran, Gulf countries and the European Union) and in the West Bank (with people visiting from Jordan), and likely (but not regular or consistent) in Bulgaria, Georgia, Greece, Israel and the United Arab Emirates. Some countries indicated that people from other countries would not enter a farm (Kuwait and Cyprus), while other countries were unsure (Armenia, Azerbaijan, Lebanon and Yemen) or did not provide any information (the Islamic Republic of Iran and Saudi Arabia).

Summary

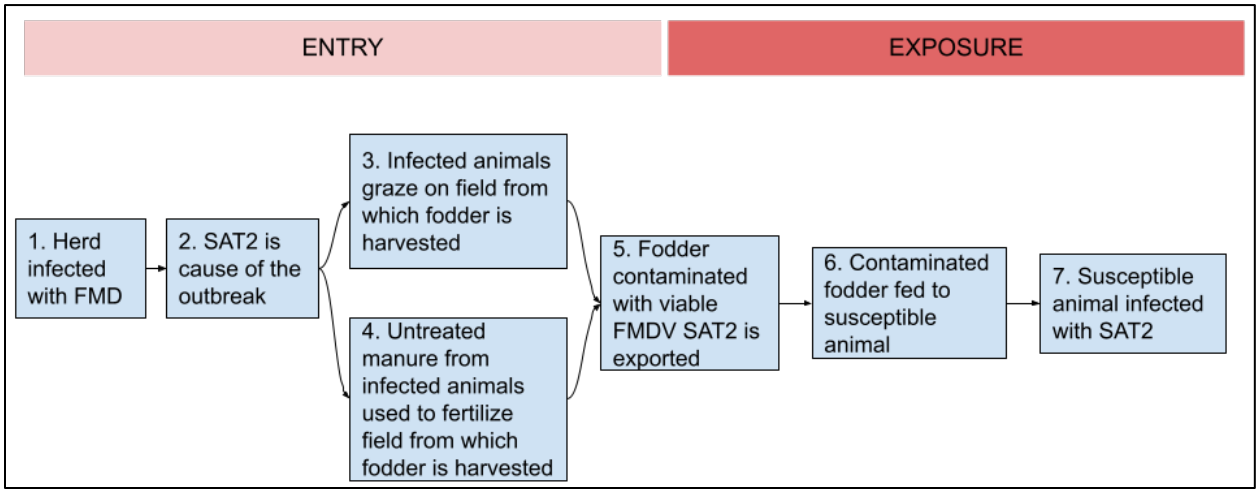
- The likelihood of FMD SAT2 spreading to unaffected countries through **people movement** is assessed as:
    - **Low** for countries that have reported contact between susceptible livestock and people from affected countries.
        - The likelihood is considered low because while it is possible that FMD SAT2 will remain viable on the clothes or equipment of someone transiting to another country who then has contact with a susceptible animal, this is only expected to occur in a few cases.
        - This applies to the Syrian Arab Republic and the West Bank due to frequent visits of people from Iraq and Jordan, respectively. There is **moderate uncertainty** for the Syrian Arab Republic and the West Bank due to the unknown magnitude of possible SAT2 contamination, as well as biosecurity measures taken on farms and implemented by travellers.

- This also applies to Bulgaria, Georgia, Greece and the United Arab Emirates, as these countries reported occasional visits of people from unspecified other countries. There is **high uncertainty** for these countries due to the unknown origin of visitors as well as potential undetected spread in nearby countries.

o **Negligible** for the other countries based on the presumptive absence of movements from affected countries. There is **high uncertainty** for countries that were unsure about people from other countries visiting farms.

Trade in fodder

Figure 7. Trade in fodder pathway



Source: Authors' elaboration.

For the purposes of this assessment, fodder is defined as food for livestock, especially dried hay or straw.

Boxes 1, 2 and 7 are described in the movement of live animals between countries pathway.

Fodder is contaminated with FMD SAT2 (Figure 7 boxes 3 and 4)

Grazing is practised in all the countries in the region. The extent to which animals graze on fields from which fodder is harvested and exported is unknown, as is the extent to which manure is used as fertilizer on these fields.

The survival of FMDV is highly dependent on pH, temperature and humidity. FMDV can survive for long periods at neutral pH, particularly at low temperatures. Faeces and other organic matter may protect FMDV and it can survive in straw for up to 15 weeks (Cottral *et al.*, 1969 cited in Davies, 2002). In one study, FMDV survived for three weeks in bovine slurry at 20°C, but less than 24 hours at 35°C (Botner and Belsham, 2012). The temperature in Diyala, Iraq, in February 2023 had an average high of 22°C and low of about 10°C, whereas in June, the temperatures averaged a low of 26°C and high exceeding 40°C. Temperatures in Erzurum, Türkiye, in February 2023 were much cooler, with a low of -20°C and a high of around 0°C; in June, temperatures averaged a low of 10°C and a high of 24°C.[4]

[4] Temperatures taken from https://www.accuweather.com/.

Contaminated fodder is exported (Figure 7, box 5)

There is extensive official trade of fodder products between the countries considered in this risk assessment (Annex B). According to FAOSTAT, Iraq, Jordan, Oman and Türkiye all exported fodder in 2020 and 2021, the most recent years for which data are available. Importing countries may have specific controls to ensure that imports of fodder do not pose a risk to animal health. Article 8.8.28 of the WOAH Terrestrial Animal Health Code outlines recommended sanitary measures for the importation of straw and fodder from FMD-infected countries or zones. It is possible that fodder is informally traded between countries, however, there are no such data on this.

Susceptible animals are exposed to viable FMDV through contaminated fodder (Figure 7, boxes 6 and 7)

Following the export of contaminated fodder, FMDV would have to remain viable to infect susceptible animals in the importing country. Susceptible animals could become infected through ingesting FMDV or inhaling aerosolized virus. Animals are relatively insensitive to experimental infection by the oral route, with the dose for pigs around 104–105 TCID50[5] and for ruminants about 105–106 TCID50 (Alexandersen, 2003). These doses are much higher than those of infection via an airborne route, which is as little as 20 TCID50 in cattle (Kitching, 2002).

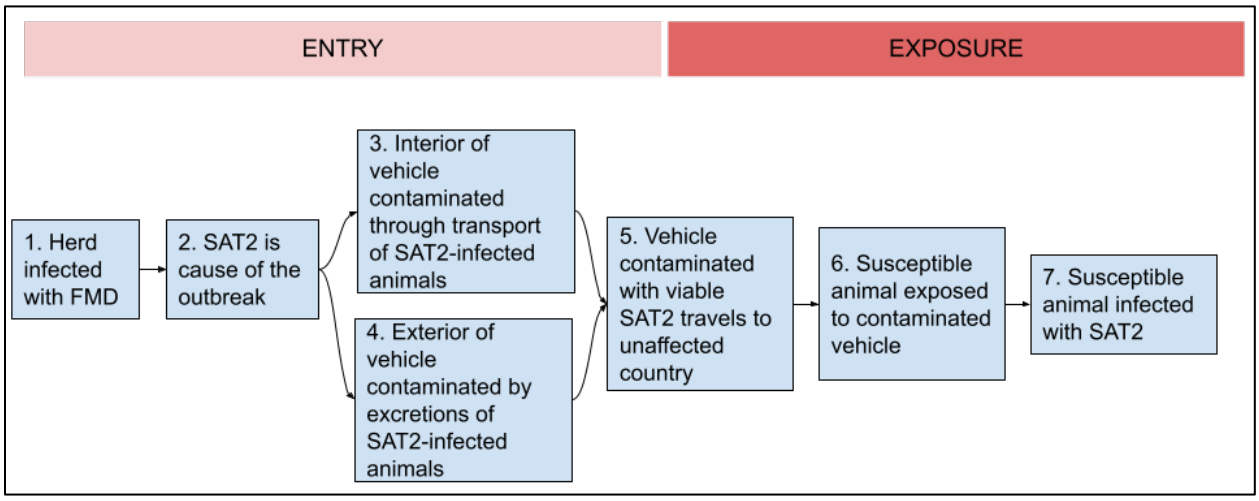
Summary

- The likelihood of FMD SAT2 spreading to unaffected countries via fodder is:
  - **Low** for countries with unofficial imports of fodder from affected countries. Due to the lack of data, it is not possible to identify these countries.
    - The likelihood is considered low because while it is possible that FMD SAT2 can contaminate fodder, remain viable in transit to another country and then come into contact with a susceptible animal, this is only expected to occur in a few cases.
  - **Low to negligible** for countries that officially imported fodder from affected countries, assuming that import sanitary measures were implemented (Bulgaria, Kuwait, Lebanon, Qatar, Saudi Arabia, the United Arab Emirates and Yemen).
    - The likelihood is negligible if sanitary measures that effectively inactivate FMDV are fully implemented.
    - If sanitary measures are not fully implemented, then the risk would be considered low.
  - **Negligible** for countries that did not import fodder from affected countries.
  - There is **high uncertainty** related to the lack of up-to-date trade data, unknown compliance with import control sanitary measures and the potential undetected spread of SAT2.

[5] TCID50 (50 percent tissue culture infectious dose): an assay used to measure the infectivity of a virus in cells.

Movements of vehicles between countries

Figure 8. Movements of vehicles between countries pathway



Source: Authors' elaboration.

Boxes 1, 2 and 7 are described in the movement of live animals between countries pathway.

Vehicle contamination with viable FMDV (boxes 3 and 4)

Vehicles can be contaminated with FMDV by transporting affected animals or driving through a contaminated environment such as a farm or livestock market. As mentioned previously (see trade in fodder pathway), FMDV survival depends on environmental conditions, but FMDV can remain viable for several weeks when protected by organic matter, especially in cool temperatures.

Cross-border movement of vehicles (Figure 8 boxes 5 and 6)

Trucks used to transport livestock are considered the most likely vehicles for cross-border spread of FMDV. However, data are limited regarding the frequency and volume of potentially contaminated vehicles travelling between countries in the region. It is likely that trucks primarily transport live animals between countries as part of formal and informal trade within the region, although ships may be used in some cases. Vehicles can act as fomites when an affected country is involved regardless of the direction of trade; for example, if an unaffected country is exporting animals to an already-affected country, vehicles can be contaminated during the off-loading process in the affected country and then return to the unaffected country.

Appropriate disinfectants can rapidly inactivate FMDV (Alexandersen, 2003). Thorough cleaning is required prior to the application of disinfectants to ensure that FMDV is not shielded from the disinfectant. Biosecurity protocols for vehicles on farms, markets and at borders are therefore an important factor in assessing the likelihood of SAT2 spread via this route. In the questionnaire survey, some countries reported that the cleaning and disinfection of vehicles at borders were not always enforced or thoroughly completed.

Summary

- The likelihood of FMD SAT2 spreading to unaffected countries via vehicles is:
  - **Low** for countries with vehicles that transport livestock to or from affected countries (as per data on formal and informal trade: Azerbaijan, Bahrain, Bulgaria, Georgia, the Islamic Republic of Iran, Lebanon, Kuwait, Qatar, Saudi Arabia, the United Arab Emirates and Yemen).
    - The likelihood is considered low because while it is possible that FMD SAT2 can contaminate a vehicle, remain viable in transit to another country and then come into contact with a susceptible animal, this is only expected to occur in a few cases.
  - **Negligible** for countries without vehicles that transport livestock to or from affected countries.
  - **Assumptions:** vehicles that transport livestock are the type of vehicle most likely to be contaminated with FMDV. Countries engaged in formal or informal live animal trade with affected countries may therefore be at risk from such vehicles.
  - In all cases, there is **high uncertainty** related to the actual movements of potentially contaminated vehicles, the implementation of biosecurity protocols to prevent or remove contamination and potential undetected spread of SAT2.

Table 3. Likelihood estimates per country/territory and risk pathway addressed

Country/territory	Live animals			Products of animal origin	Wildlife (boar)	Fodder	People	Vehicles
	Official trade	Informal trade	Common grazing	Official trade		Official trade		
Armenia	N	N	N	N	L	N	N	N
Azerbaijan	L	M	N	L	L-N	N	N	L
Bahrain	L	NA	NA	N	N	N	NA	L
Bulgaria	N	L	N	N	L–N	L–N	L	L
Cyprus	N	N	N	N	N	N	N	N
Georgia	N	N	M	L	L	N	L	L
Greece	N	N	N	N	L–N	N	L	N
Iran (the Islamic Republic of)	L	NA	H	N	L	N	NA	L
Iraq								
Israel	N	N	N	L	L	N	N	N
Jordan								
Kuwait	N	N	N	N	N	L–N	N	L
Lebanon	N	N	N	L	L–N	L–N	N	L
Oman								
Qatar	L	NA	NA	N	N	L–N	NA	L
Saudi Arabia	L	NA	NA	N	N	L–N	NA	L

Country/territory	Live animals			Products of animal origin	Wildlife (boar)	Fodder	People	Vehicles
Syrian Arab Republic	N	H	N	L	L	N	L	L
Türkiye								
United Arab Emirates	L	M	N	N	N	L–N	L	L
West Bank	N	N	N	L	L	N	L	N
Yemen	N	N	H	N	N	L–N	N	L

Notes: H = high; M = moderate; L = low; N = negligible; NA = not assessed. Light grey cells: moderate uncertainty. Dark grey cells: high uncertainty. The red font indicates that countries did not respond to the questionnaire survey.
Source: Authors' elaboration.

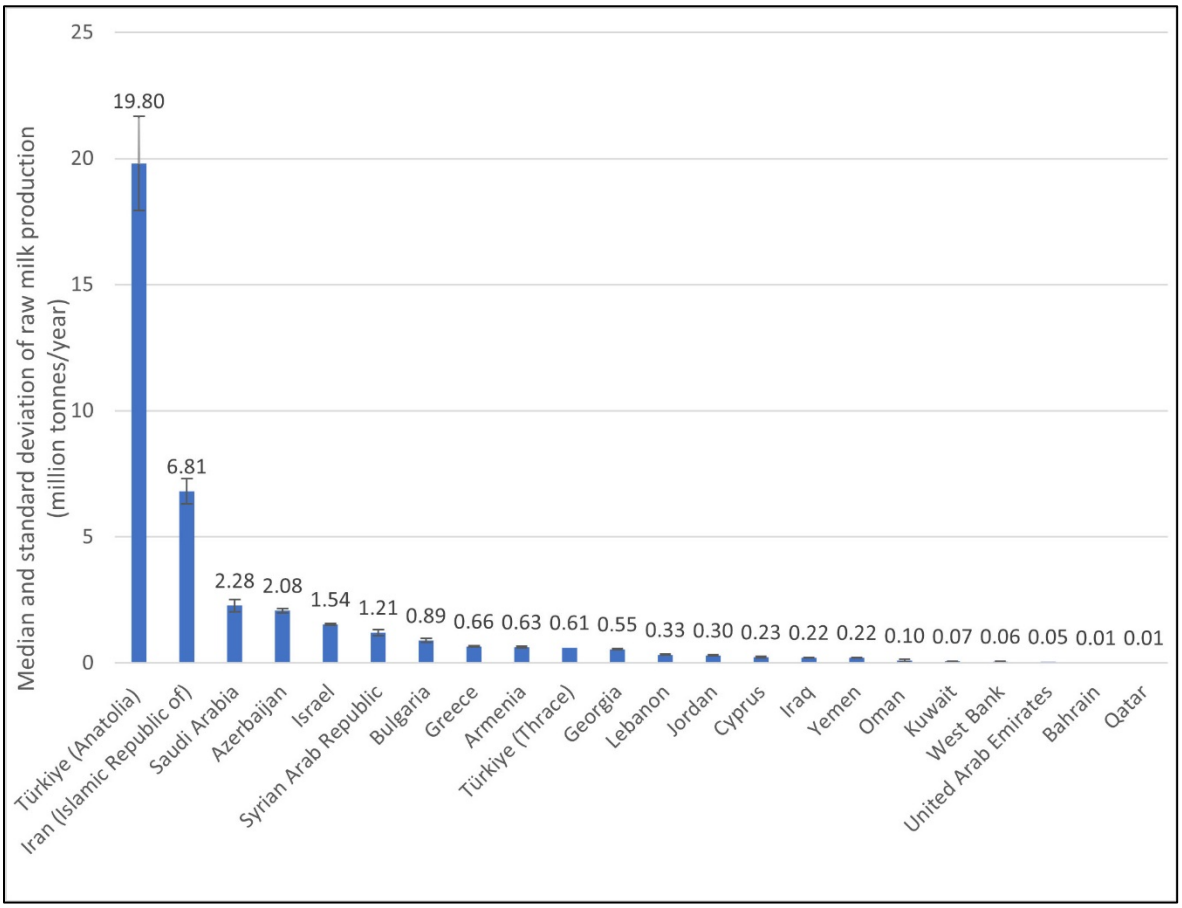
Impact of FMD SAT2 in the Near East and west Eurasia

Estimating production losses and additional costs of the spread of SAT2 in target countries

Livestock production data from FAOSTAT (FAO, 2023c) for the 21 countries[6] included in this analysis were used to conduct an economic impact analysis (Annex D and Annex E). The production data from 2016 to 2021 were related to meat (fresh or chilled), raw milk and raw hides and skins of cattle, sheep, goats, pigs and buffaloes. In total, 257 million head of livestock were reported in these countries in 2021 with the largest proportion consisting of sheep and goats (61 percent and 22 percent), followed by cattle (14 percent) and pigs, camels and buffaloes (each about 1 percent). Among the products considered, raw milk had the highest production volume in 2021 at about 47 million tonnes, followed by meat at 4.8 million tonnes and hides and skins at 591 000 tonnes. About 87 percent of the raw milk produced in these countries was from cows, 8 percent from sheep and 4 percent from goats, with the rest from camels and buffaloes. Türkiye (specifically Anatolia, where FMD is endemic, with 97 percent of production, and Thrace, which is FMD-free with vaccination, with 3 percent of production) and the Islamic Republic of Iran were the top two milk producers in the region with about 53 percent and 18 percent of the total milk produced, respectively. Saudi Arabia and Azerbaijan (5 percent each), Israel (4 percent) and the Syrian Arab Republic (3 percent) were the next highest milk producers. The rest of the 14 countries accounted for about 11 percent of the total milk production. Figure 9 presents the median and standard deviation of raw cow milk produced in 2016–2021 in millions of tonnes per year in the region.

[6] Armenia, Azerbaijan, Bahrain, Bulgaria, Cyprus, Georgia, Greece, the Islamic Republic of Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, the Syrian Arab Republic, Türkiye, the United Arab Emirates and Yemen.

Figure 9. Median and standard deviation of raw cow milk produced in 2016–2021 in millions of tonnes per year



Source: Based on data from **FAO**. 2023. *FAOSTAT*. Rome. [Cited 21 September 2023]. www.fao.org/faostat/en/#home

The economic impact of SAT2 could be considered under two main categories:

1. Direct costs: These include losses due to mortality, reduced productivity, the likely impact of SAT2 on herd structure, fertility and reproduction, as well as a delay in the sale of animals or POAO.
2. Indirect costs: These include the implementation of control measures such as vaccination campaigns, quarantines and culling, as well as the provision of veterinary services, laboratory diagnostics, surveillance programmes and compensation for losses to affected farmers. They also encompass wide economic consequences beyond animal health, including trade disruptions, market access restrictions, reduced exports and a loss of consumer confidence in livestock products. Indirect costs also affect related industries, such as feed suppliers, processors and transporters.

In this analysis, only expected potential direct and indirect costs have been estimated to demonstrate the possible magnitude of the impact of SAT2 spreading to the region. Annex F presents production parameters affected and the magnitude of impact used in this analysis. For further insight on other types of indirect costs and impacts associated with the spread of SAT2, models that are focused on regional and global supply and demand, such as partial and general equilibrium models, should be used.

Scenarios

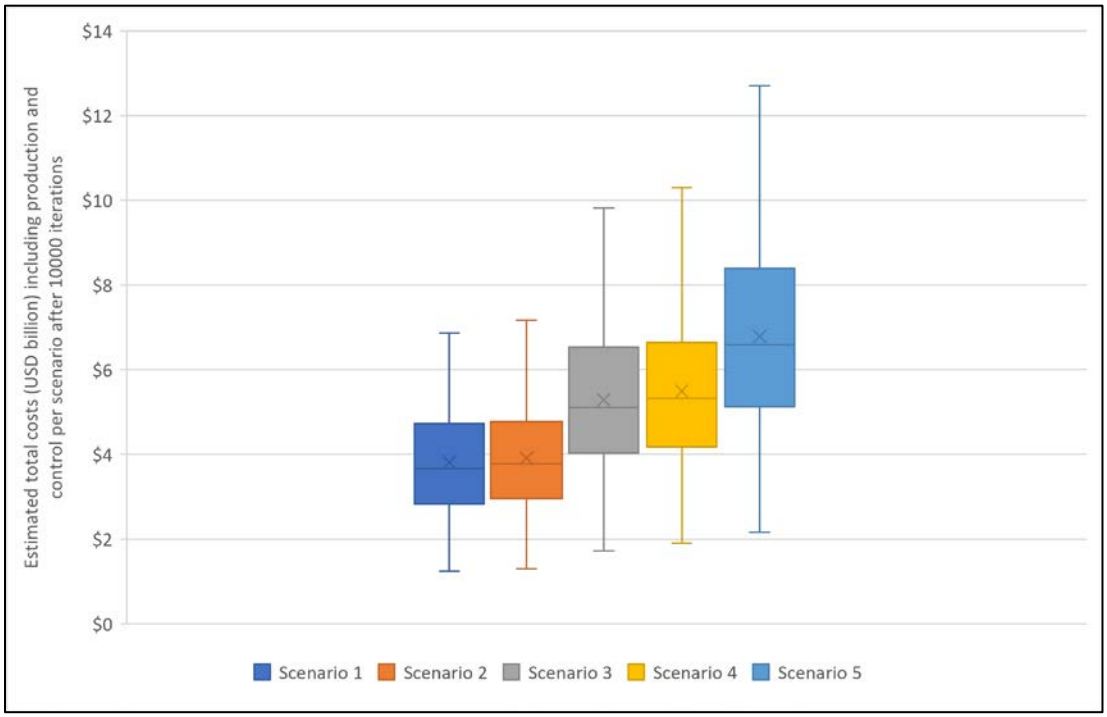
The analysis was carried out under five main scenarios each representing different potential spread direction patterns from the known affected countries. These are:

- Scenario 1 (no further spread; known affected countries only): Jordan, Iraq, Oman and Türkiye.
- Scenario 2 (westward spread to FMD-free countries): Jordan, Iraq, Oman and Türkiye *plus* Bulgaria, Cyprus and Greece.
- Scenario 3 (eastward spread to countries neighbouring Anatolia): Jordan, Iraq, Oman and Türkiye *plus* Armenia, Georgia, the Islamic Republic of Iran and the Syrian Arab Republic.
- Scenario 4 (spread to countries neighbouring Iraq): Jordan, Iraq, Oman and Türkiye *plus* the Islamic Republic of Iran, Kuwait, Qatar, Saudi Arabia and the Syrian Arab Republic.
- Scenario 5 (widespread in all 20 countries): worst-case scenario.

A Monte Carlo simulation model built in Microsoft Excel[7] was used by running 10 000 iterations for each scenario to explore the impact of potential variabilities (see Annex F).

The boxplot of the variation in estimated total costs (USD billion), including production losses and control costs, per scenario after 10 000 iterations under the five scenarios is illustrated in Figure 10. As expected, Scenario 5 (all countries) was the costliest scenario with a median potential cost of USD 6.5 billion, followed by Scenario 4 with an estimated median cost of USD 5.3 billion. Scenario 3 showed a potential total cost of USD 5.1 billion. The potential costs of Scenario 2 and Scenario 1 were quite close with median costs at USD 3.8 and USD 3.6 billion, respectively.

Figure 10. Variation in estimates total costs (USD billion) per scenario after 10 000 iterations

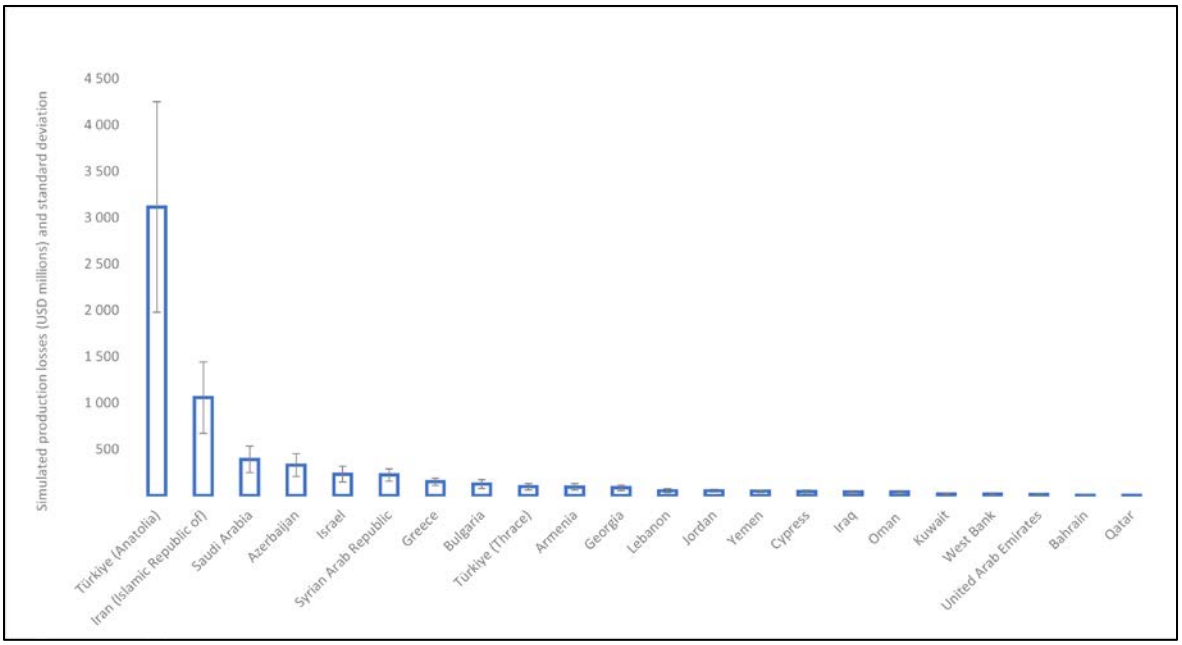


Source: Authors' elaboration.

[7] RiskSim for Excel by TreePlan.com, 2022.

Figure 11 illustrates the simulated median and standard deviation of the potential production losses (USD millions) that could be expected from an SAT2 incursion given the parameters provided in Annex F. Production losses are expected to contribute to about 95 percent of the total costs. In the case of SAT2 spreading to the top four highest-producing countries in the region (Türkiye, the Islamic Republic of Iran, Saudi Arabia and Azerbaijan) and in the case of high morbidity (which could be expected following late detection of FMDV or a lack of effective control measures), the total cost imposed could represent about 79 percent of the total possible cost for the region. The 10 lowest-producing countries represent 4.5 percent of the total economic impacts. The production losses reported for the recent SAT2 outbreak in Jordan were estimated to be USD 49.3 million, resulting from a 30-percent reduction in milk production (ProMED, 2023). This is close to the result of the current analysis for Jordan, where a loss of USD 44.5 million was estimated. In addition to production losses, net livestock- and meat-importing countries may face increased livestock and meat prices as a result of having to shift their trade partners to SAT2-free countries.

Figure 11. Simulated median and standard deviation of production losses (USD millions)



Source: Authors' elaboration.

Importance of livestock on food and nutrition security, the economy, labour and the livelihoods of those most vulnerable

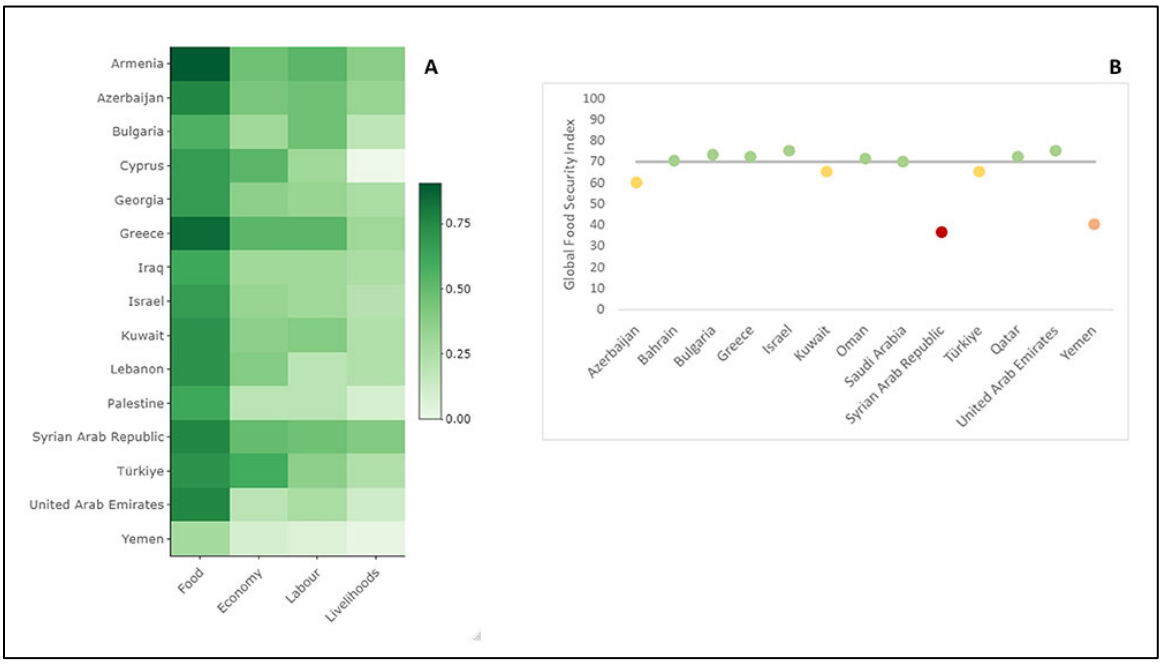
The importance of different domestic species in the countries included was assessed using data collected from the questionnaire distributed to veterinary services. The questionnaire asked respondents to indicate the importance of domestic livestock susceptible to FMD (cattle, sheep, goats and pigs) and their products (meat, dairy and milk products, leather, wool and cashmere) in terms of four main areas:

1. households' food and nutrition security
2. the country's economy
3. the local labour market
4. the livelihoods of those most vulnerable

Data were collected using qualitative categories: extremely important, important, not very important and not important at all. Each category was converted into numerical weights, with extremely important given a value of 3 and not important at all a value of 0. A standardized score was then calculated for each country in the four areas, to take into account the minimum and maximum potential score in each area. These standardized scores were compared across countries and areas (Figure 12). To characterize food and nutrition security (prior to SAT2 circulation in the region), the 2022 Global Food Security Index (GFSI) (Economist Impact, 2022) was used for countries when available.

In most countries, food from animal sources is essential for food and nutrition security. The Syrian Arab Republic was identified as the country most vulnerable to food insecurity, with an already 'very weak' GFSI (Ibid.), low meat and milk production (FAO, 2021) and a high dependence on beef, sheep meat and dairy products for the population's food and nutrition security (Figure 12). Azerbaijan, Kuwait and Türkiye are also vulnerable, with a 'moderate' GFSI and dependence on local POAO for their population's food and nutrition security. In contrast, Yemen's GFSI was categorized as 'weak' in 2022, and meat and milk production was very low (Ibid.), though the country reported being less reliant on beef and dairy products for its population's food and nutrition security (Figure 12).

Figure 12. Heat map of the importance of livestock (cattle, sheep, goats and pigs) and POAO for countries' food and nutrition security, economies, labour markets, and the livelihoods of those most vulnerable (A); and 2022 GFSI for available countries (B)



Source: Economist Impact. 2022. *Global Food Security Index 2022*. https://impact.economist.com/sustainability/project/food-security-index/reports/Economist_Impact_GFSI_2022_Global_Report_Sep_2022.pdf

Overall risk estimation

Risk is defined as the product of the likelihood of an unwanted event occurring and the consequences of that unwanted event. This analysis estimates the consequences in terms of economic impacts and the importance of livestock on countries' food and nutrition security, economies and labour markets and the livelihoods of those most vulnerable. Both likelihood and consequences should be considered when estimating the overall risk of SAT2 entering and becoming established in a new country or territory.

Using Azerbaijan as an example, the likelihood of inclusion was low to negligible via wildlife, low through legal trade and contaminated vehicles and moderate through informal trade in live animals (Table 3). However, Azerbaijan is the fourth largest milk producer in the region with 2.08 million tonnes (Figure 9); an outbreak of FMD SAT2 would therefore result in median production losses of USD 450 million. Furthermore, Azerbaijan is already vulnerable to food and nutrition insecurity: it had a 'moderate' GFSI score in 2022 and depends on local POAO to fulfil its population's food and nutrition security. So, even though the likelihood of an SAT2 outbreak is low for most of the routes considered, the consequences for the milk industry, as well as to access to and availability of POAO in Azerbaijan would be severe if SAT2 were to enter the country.

Discussion and recommendations

Prevention of FMD and other infectious diseases is more effective than control. As resources are always limited, prevention should be risk-based and targeted to specific areas, holdings and the highest risk pathways (Table 3 and Table 4). The likelihood of exposure, infection and spread can also vary over time or change seasonally. For example, there is a large increase in animal movements during festival periods such as Eid al-Adha (*qurban*), which increases the probability of FMD spreading. Another example of seasonal variation in risk is that the spread of FMD may be more likely in winter and early spring months because FMDV is very sensitive to temperature changes and remains viable for much longer in cooler weather. As seasonal temperature changes and events such as festivals are known in advance, strategic communications, surveillance and control measures can be put in place in advance to mitigate risks.

For FMD, as well as many other infectious diseases, direct contact between infected and susceptible animals is the most effective route of transmission. Ensuring that only healthy animals (known to be FMD-free) are moved is therefore crucial to mitigate the risk of FMD spreading within and between countries. However, this is challenging in many countries and requires cooperation and compliance of all stakeholders.

Sanitary measures that effectively mitigate the risks of trade in live animals and associated products are described in the WOAH Terrestrial Animal Health Code. However, illegal or informal movements do not apply these measures. Trade between countries could be made safer by facilitating compliance with the official trade regulations, which in turn would help ensure that sanitary measures are applied. Raising awareness about FMD prevention is also crucial, as this will enable stakeholders to better protect their livestock and livelihoods.

An outbreak of FMD SAT2 would have a substantial negative impact in all countries considered in this risk assessment, though to a varying extent in terms of the level of impact and sector most affected.

Total production losses would be highest in the Anatolian part of Türkiye followed by the Islamic Republic of Iran, which are the two countries with the highest milk production. In Jordan and Türkiye, where FMD SAT2 has already been reported, a series of control measures were put in place, such as the closure of livestock markets for a period of time and animal movement restrictions. Although important to control the spread of the disease, these measures negatively impacted the livelihoods of farmers and other actors in the value chain, including those without cases of FMD. Vaccination campaigns were a further measure introduced in the countries (using both imported and locally produced vaccines), which resulted in additional costs and used resources that were subsequently not available to other sectors.

Aside from the economic impact, food access and availability would also be affected. Food from animal sources is essential for food and nutrition security in almost all of the countries considered, with some countries (Azerbaijan, Kuwait, the Syrian Arab Republic and Türkiye) already vulnerable to food insecurity. FMD SAT2 outbreaks would therefore exacerbate the already critical situation in these countries.

In countries that are currently FMD-free without vaccination (Bulgaria, Cyprus and Greece), stricter control measures (such as tighter movement control and stamping out) would be implemented to regain official recognition of an FMD-free status as soon as possible. However, such measures would result in additional costs related to controlling the spread of the disease in the short term (for example, diagnostics, outbreak investigation, stamping out, compensation, cleaning and disinfection, awareness-raising campaigns and surveillance) and potentially targeted vaccination in the medium term. Trade bans and restrictions imposed until an FMD-free status is regained would place an additional economic restraint on the cattle, sheep and pig industries in these countries, especially in Cyprus where livestock represents 75 percent of the gross domestic product from agriculture.

All countries should have an emergency response plan for FMD that details how to manage a sudden increase in cases, such as would be expected with the introduction of a novel serotype such as SAT2. The response plan needs to be realistic for the country and supported with adequate resources for implementation when needed, and ideally should be tested through regular and realistic simulation exercises. Such an emergency plan may be stand-alone, or a part of a strategy for controlling or eradicating endemic FMD.

This qualitative risk assessment was conducted with data available up to June 2023. It aims to shed light on high-risk pathways for the introduction of FMD SAT2 and guide policy interventions to mitigate the risk in unaffected countries and territories in the Near East and west Eurasia. Primary data from 14 countries via the questionnaire were combined with secondary data sources to conduct the likelihood and impact assessments. However, significant uncertainty remains in many of the assessments due to:

- factors inherent in the pathways for which data are lacking (for example, informal trade and the level of compliance with biosecurity and sanitary measures)
- the possibility of an undetected or unreported spread of SAT2 to additional countries in the region, from which further spread may occur
- knowledge gaps, such as the susceptibility of wildlife to SAT2

Table 4. Preventive measures targeting major risk pathways for the introduction of FMDV

Risk pathway	Preventive measures
All	• Verify that an FMD contingency plan exists to manage a deterioration of the FMD situation (for example, due to the introduction of a new serotype). This contingency plan must be backed with adequate resources and standard operating procedures for surveillance and outbreak control measures. • Verify that laboratories have the capacity to rapidly confirm suspected cases, including the determination of the causative serotype. • Monitor the global FMD situation regularly using information sources such as the FMD Global Quarterly Report[8] published by WRLFMD, FAO's EMPRES Global Animal Disease Information System (EMPRES-i)[9] and WOAH's World Animal Health Information System (WAHIS).[10] Import requirements for specific trading partners may be adjusted as appropriate. • Preventively vaccinate susceptible livestock, applying a risk-based approach.

[8] See https://www.wrlfmd.org/ref-lab-reports.
[9] See https://empres-i.apps.fao.org/.
[10] See https://wahis.woah.org/#/home.

Risk pathway	Preventive measures
	• Encourage and facilitate stakeholder reporting of suspected cases of FMD by ensuring that the right incentives and compensation are available. • Implement an early warning system based on reports of increased mortalities (particularly young stock) and observations at slaughterhouses or panic sales, using information from farmers, traders, paraveterinary workers, inspectors and relevant social media sites. • Support and improve the performance and infrastructure of veterinary services. • Adopt public-private partnership approaches when appropriate. • Raise the awareness of all stakeholders about FMD, including its impact and consequences at local, national and regional levels.
Live animal movements: Legal trade Informal trade Common grazing	• Follow required sanitary measures outlined in the WOAH Terrestrial Animal Health Code when importing live animals from countries where different FMDV serotypes and strains are circulating. • Reinforce capacities at borders and along the value chain to ensure full compliance with required sanitary measures. • Carry out targeted surveillance in livestock markets near borders and during festivities when more animals are expected to be moved and sold. This might include increased surveillance of small ruminants (more detailed clinical checks for mild clinical signs). • Discourage informal cross-border movements by facilitating compliance for legal movements as well as fines, penalties or disincentives. • Discourage the mixing of different consignments during transportation and at markets. Ensure markets are thoroughly cleaned and emptied between sales (rest days). Consider a livestock standstill if FMD is suspected. • Separate sick animals from other livestock and ensure they are examined by an animal health professional. Sick animals should never be moved long distances or sold. • Ensure there are continuous awareness-raising campaigns among farmers, traders and other stakeholders about the clinical signs of FMD, reporting requirements and effective biosecurity measures, such as observing a quarantine period prior to introducing new animals to a herd or flock.
Trade in meat and milk of FMD-susceptible animals: Legal Informal	• Follow required sanitary measures outlined in the WOAH Terrestrial Animal Health Code when importing POAO from countries where different FMDV serotypes and strains are circulating. • Reinforce capacities at borders and along the value chain to ensure full compliance with required sanitary measures. • Implement fines, penalties or disincentives to discourage informal imports for commercial or personal use. • Raise awareness about FMD among the general public, particularly travellers, as well as relevant stakeholders (livestock owners and workers, veterinarians, etc.), especially on the importance of the proper treatment of swill or avoiding swill-feeding altogether. • Review regulations related to swill-feeding, including compliance, and reinforce as required. • Assess the risk of wild boar exposure to contaminated foodstuffs and take appropriate mitigation measures.
Wildlife	• Raise awareness about FMD and the potential risk of contact between susceptible wildlife and domestic animals.

Risk pathway	Preventive measures
	• Conduct FMD surveillance in wildlife (via hunters or non-invasive sampling). • Consider country-specific risk assessment surveillance of the risk of FMD in wildlife and its transmission to livestock.
Fodder	• Follow required sanitary measures outlined in the WOAH Terrestrial Animal Health Code when importing animal feed or fodder from countries where different FMDV serotypes and strains are circulating. • Reinforce capacities at borders and along the value chain to ensure full compliance with required sanitary measures. • Implement fines, penalties or disincentives to discourage informal imports for commercial or personal use.
People	• Ensure there are continuous awareness-raising campaigns among farmers, livestock workers and other stakeholders about the clinical signs of FMD and effective biosecurity measures, such as changing clothes and footwear when visiting different farms.
Vehicles	• Review regulations on the cleaning and disinfection of vehicles carrying livestock, including compliance, and reinforce as required. • Raise awareness among drivers and other value chain actors about FMD and effective biosecurity measures, such as cleaning and disinfection.

Source: Authors' elaboration.

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Annexes

Annex A. Summary of responses to selected questions in the questionnaire circulated to target countries

	Fomite		Pigs and wild boar 0 = no; 1 = yes, rare; 2 = common in some places; 3 = common; U = unsure; N/A = not applicable; NR = not recorded				Surveillance and laboratory 0 = none; 1 = few (< 25%); 2 = often (25–75%); 3 = most (75–95%); 4 = all (95–100%); N/A = not applicable				SAT2 vaccine		Preparedness: self-assessment (H = high; M = medium; P = poor)		
Country	Vehicles thoroughly cleaned at border	People from abroad visit farms	Swill-feeding frequency	Access to landfill	Direct contact with livestock	On grazing land	Percentage of animals that had an ante-mortem inspection	Percentage of livestock owners that report suspected FMD	Laboratory tests per outbreak (last 6 months)	Capacity to test for SAT2 in a laboratory	Available	Use	Laboratory diagnosis	Quarantine and movement	Vaccination
Armenia	Always	Unsure	1	1	1	U	4	3	N/A	Yes	Yes*	Yes*	M	M	P
Azerbaijan	Always	Unsure	0	0	0	2	3	3	N/A	Yes	Planned	No	H	H	H
Bulgaria	*Always	Unlikely	0	1	0	3	4	3	N/A	U	No	No	H	H	M
Cyprus	Usually	Unlikely	0	0	0	0	4	3	N/A	Yes	No	No	M	M	M
Georgia	Always	Occasionally	1	0	1	U	4	2	4	Yes	Yes*	Yes*	H	M	P
Greece	Always	Occasionally	3	2	2	3	4	3	N/A	No	No	No	M	H	M
Iraq	Not enforced	Unsure	N/A	N/A	N/A	N/A	2	2	2	Yes	No	No	P	M	P
Israel	Usually	Occasionally	0	1	2	2	3	3	4	Yes	Yes	Yes	H	M	M
Kuwait	Always	Unlikely	N/A	N/A	N/A	N/A	4	3	N/A	Yes	Yes	Yes	H	H	H
Lebanon	Usually	Unsure	NR	U	U	U	1	1	N/A	Yes	Planned	No	M	P	P
Syrian Arab Republic	Always	Frequently	N/A	0	0	0	3	3	4	No	Planned	No	M	M	P
Türkiye	Always	Unsure	NR	2	2	2	3	3	4	Yes	Yes	Yes	H	H	H

	Fomite		Pigs and wild boar 0 = no; 1 = yes, rare; 2 = common in some places; 3 = common; U = unsure; N/A = not applicable; NR = not recorded				Surveillance and laboratory 0 = none; 1 = few (< 25%); 2 = often (25–75%); 3 = most (75–95%); 4 = all (95–100%); N/A = not applicable				SAT2 vaccine		Preparedness: self-assessment (H = high; M = medium; P = poor)		
Country	Vehicles thoroughly cleaned at border	People from abroad visit farms	Swill-feeding frequency	Access to landfill	Direct contact with livestock	On grazing land	Percentage of animals that had an ante-mortem inspection	Percentage of livestock owners that report suspected FMD	Laboratory tests per outbreak (last 6 months)	Capacity to test for SAT2 in a laboratory	Available	Use	Laboratory diagnosis	Quarantine and movement	Vaccination
United Arab Emirates	Always	Occasionally	0	N/A	N/A	N/A	4	3	4	No	Yes	Yes	H	H	H
West Bank	Not enforced	Frequently	0	2	0	3	1	2	4	Yes	Planned	No	M	P	P
Yemen	No control	Unsure	N/A	N/A	N/A	N/A	1	2	0	No	No	No	P	M	P

Note: *Information taken from **FAO EuFMD**. 2023. *Report on significant FAST diseases events and information*. April–June 2023. EuFMD Pillar II.

Source: **FAO**. 2023. *Questionnaire to assess the risk and impacts of further spread of foot and mouth disease serotype SAT2 in west Eurasia.* Rome.

Annex B. Connections between countries/territories via trade relations in live animals, POAO and fodder

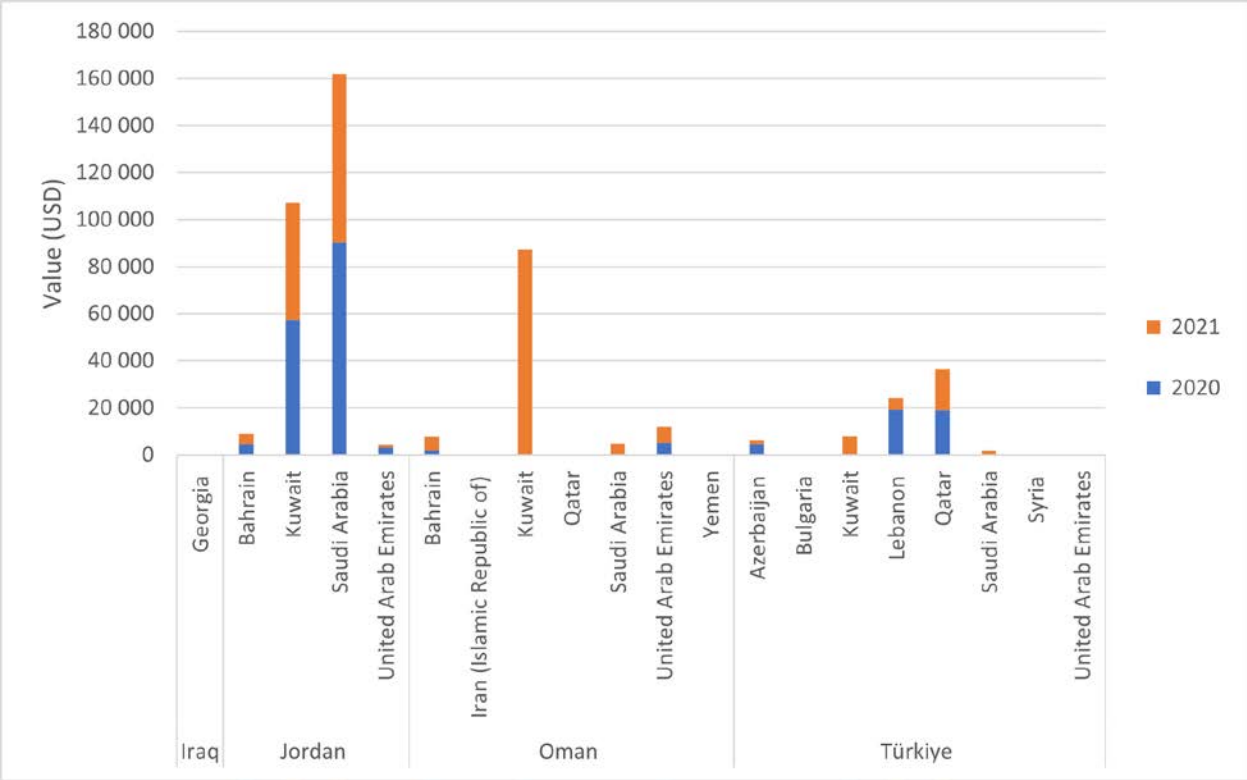
		To																			
	Country	Armenia	Azerbaijan	Bahrain	Bulgaria	Cyprus	Georgia	Greece	Iran (Islamic	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syrian Arab	Türkiye	United Arab	West Bank	Yemen
From	Armenia	-					A, M, D					M	A, M, F	A, M		A, M				A, M, D		
	Azerbaijan		-				A, C, M, D, F						F			F			F	M, D, F		
	Bahrain			-								D	M, D, F	D, F	M, D		M, D		D	A, M, D, F		D
	Bulgaria		A, D	D, F	-	M, D	A, M, D, F	A, M, D, F		F	D	D, F	D, F	D, F	D	M, D, F	D, F		A, D, F	A, M, D, F		
	Cyprus		D	D	M, D	-	M	M, D			D	M, D	D	A, M	M, D	A, D	D		M, D	A, M, D		
	Georgia	D	A*, M, D	A, M			-		D	F	M	F	A, M	A, F	A	A, M	A, F		F	A, M, D, F		
	Greece	A, M, D, F		M, D	A*, M, D, F	A, M, D, F	M, D	-			D	D	M, D	A, D, F	M	M, D	D		M, D, F	M, D, F		
	Iran (Islamic Republic of)	M, D	D	M, D			A, D		-			F	A, M, D, F	D	A, M, D, F	A, F			M, D, F	A*, M, D, F		
	Iraq			M			A		C	-		F						A*, C	M, D	A, M, D, F		
	Israel					D		M			-	F	A						D	D	A, M, D, F	
	Jordan		M	A, M, D								-	M, D	M, D	M, D	M, D	A, M, D, F	D		A*, M, D, F	D	M, D, F

		To																			
	Country	Armenia	Azerbaijan	Bahrain	Bulgaria	Cyprus	Georgia	Greece	Iran (Islamic	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syrian Arab	Türkiye	United Arab	West Bank	Yemen
From	Kuwait			A, M, D					D			A, M, D	-	D	M, D, F	A, M, D, F	M, D			M, D		
	Lebanon			A, M, D								M, F	A, M, D, F	-	D	A, M, D, F	D, F	F		A, M, D		M, D
	Oman			A, M, D					A, M, D			D	A, M, D		-	A, M, D, F	A, M, D			A, M, D, F		A, C, M, D, F
	Qatar												M, D		M, D, F	-						
	Saudi Arabia		M, D	A, M, D, F								A, M, D, F	A, M, D	M, D	A, M, D, F		-	M, D	M, D	A, M, D, F	D	A*, C, M, D, F
	Syrian Arab Republic			D								D, F	D	A*, C, D, F	D	D	M, D, F	-	D	A, D		
	Türkiye		A*, M, D	M, D, F	A*, D, F		M, D	F	C, M, D	A*,F	D,F	M, D	A, M, D, F	A*, M, D, F	M, D	A, M, D, F	A, M, D, F	A, M, D, F	-	A*, M, D, F	D	M, D
	United Arab Emirates			A, M, D, F			M		A, M, D, F			M, D	A, M, D, F	M, D	A, M, D, F	F	A, M, D, F	D	M, D	-	D	A, M, D, F
	West Bank			D								M	M, D				M, D			M, D	-	
	Yemen			D									D		D, F					M, D, F		-

Notes: *Presumptive informal trade of live animals. A = live animals; C = common grazing; D = dairy products; F = fodder; M = meat products. Black text indicates formal trade in 2020–2021 (FAOSTAT, 2023). Red text indicates formal and/or informal trade of POAO since December 2022 reported via the questionnaire.

Source: **FAO**. 2023. *Questionnaire to assess the risk and impacts of further spread of foot and mouth disease serotype SAT2 in west Eurasia.* Rome.

Annex C. Value of imports of live cattle, small ruminants and pigs from affected countries and others included in the risk assessment



Source: **FAO.** Detailed trade matrix. In: *FAOSTAT*. Rome. [Cited 21 September 2023]. www.fao.org/faostat/en/#data/TM

Annex D. Meat, milk and hide/skin production data for 2021

	Production in tonnes *1 000														
	Beef	Goat meat	Sheep meat	Pork	Camel meat	Buffalo meat	Raw buffalo milk	Raw camel milk	Raw cow milk	Raw goat milk	Raw sheep milk	Buffalo hides	Cow hides	Goat hides	Sheep hides
Armenia	57.4	0.0	10.9	18.9	-	-	-	-	622.3	4.0	47.0	-	7.8	0.0	1.5
Azerbaijan	145.0	-	87.6	0.5	-	-	-	-	2 187.8	5.1	30.5	-	24.8	-	9.9
Bahrain	0.8	0.2	25.0	-	0.1	-	-	-	10.0	0.3	0.2	-	0.2	0.0	3.9
Bulgaria	18.2	1.9	8.7	80.7	-	-	16.6	-	835.8	30.3	70.4	-	-	-	-
Cyprus	5.9	2.5	2.6	43.7	-	-	-	-	298.1	40.1	44.5	-	-	-	-
Georgia	20.5	-	4.4	21.8	-	-	-	-	577.3	3.4	7.3	-	3.1	-	0.9
Greece	33.1	22.1	63.8	74.8	-	-	-	-	710.9	365.2	951.7	-	-	-	-
Iran (Islamic Republic of)	336.3	38.4	238.1	-	5.1	6.6	128.0	-	7 036.3	301.7	386.4	1.1	43.1	6.9	39.5
Iraq	34.8	11.6	46.9	-	1.8	6.2	39.4	0.4	218.7	22.4	58.3	1.0	3.9	2.4	8.8
Israel	139.7	3.4	39.4	13.4	0.1	-	-	-	1 528.3	25.0	19.0	-	14.2	0.6	6.1
Jordan	48.6	6.5	27.3	-	0.7	-	-	-	309.1	11.3	97.1	-	6.0	1.2	3.9
Kuwait	2.3	1.1	52.0	-	2.3	-	-	-	68.0	6.1	0.3	-	0.3	0.1	11.8
Lebanon	45.5	3.1	4.5	0.7	-	-	-	-	337.4	29.1	18.2	-	4.7	0.5	0.8
West Bank	18.3	4.5	12.0	-	-	-	-	-	66.4	22.3	53.5	-	2.6	0.9	2.4
Oman	15.6	18.2	32.2	-	16.9	-	-	-	219.6	114.6	24.3	-	1.8	1.8	2.1
Qatar	1.8	1.1	8.2	-	1.4	-	-	18.9	7.5	9.6	12.3	-	0.3	0.2	1.1
Saudi Arabia	40.0	52.9	90.6	-	108.3	-	-	135.3	2 600.0	96.0	84.8	-	5.8	9.4	15.6
Syrian Arab Republic	63.0	10.5	160.4	-	0.6	0.4	6.7	-	1 236.0	104.6	703.4	0.1	9.7	1.9	26.6
Türkiye	1 460.7	94.6	385.9	-	-	10.8	63.6	-	21 370.1	622.8	1 143.8	1.5	163.6	12.0	70.2

	Production in tonnes *1 000														
	Beef	Goat meat	Sheep meat	Pork	Camel meat	Buffalo meat	Raw buffalo milk	Raw camel milk	Raw cow milk	Raw goat milk	Raw sheep milk	Buffalo hides	Cow hides	Goat hides	Sheep hides
United Arab Emirates	19.2	63.2	4.1	-	39.1	-	-	78.3	52.6	75.9	31.9	-	1.6	8.0	0.7
Yemen	96.4	84.5	45.2	-	2.6	-	-	2.6	224.5	68.9	51.3	-	18.0	16.9	8.9

Source: **FAO.** 2023. *FAOSTAT.* Rome. [Cited 21 September 2023]. www.fao.org/faostat/en/#home

Annex E. Population of livestock per country in 2021

	Number of livestock (head)					
Country	Cattle	Goats	Sheep	Pigs	Camels	Buffaloes
Armenia	580 567	22 522	631 094	195 961	-	698
Azerbaijan	2 519 692	585 520	7 314 166	5 954	332	129 137
Bahrain	7 500	25 000	60 000	-	1 094	-
Bulgaria	611 200	215 000	1 199 550	694 660	-	21 690
Cyprus	84 610	-	-	360 680	-	-
Georgia	925 800	50 300	896 200	165 700	-	19 969
Greece	564 000	2 844 000	7 253 000	733 000	-	6 000
Iran (Islamic Republic of)	5 343 674	16 954 895	45 269 666	-	152 346	162 424
Iraq	2 061 427	1 376 393	6 754 123	-	106 361	242 161
Israel	530 000	116 000	520 000	163 610	5 616	-
Jordan	78 477	803 940	3 085 261	-	13 643	95
Kuwait	31 769	219 756	748 532	-	14 556	-
Lebanon	86 820	531 289	431 285	6 874	131	-
West Bank	67 760	239 966	771 168	-	-	-
Oman	421 950	2 443 150	642 330	-	284 540	-
Qatar	50 721	384 703	921 379	-	119 560	-
Saudi Arabia	700 000	6 095 789	9 367 317	-	498 618	-
Syrian Arab Republic	872 307	1 906 542	16 783 185	26	35 893	6 432
Türkiye	17 850 543	12 341 514	45 177 690	1 353	1 204	185 574
United Arab Emirates	104 648	2 381 525	2 082 077	-	511 226	-
Yemen	1 661 997	9 343 908	9 256 539	-	453 296	-

Source: **FAO.** 2023. *FAOSTAT.* Rome. [Cited 21 September 2023]. www.fao.org/faostat/en/#home

Annex F. Production parameters affected and magnitude of impact used in this analysis

Type of impact	Magnitude of impact					
	Cattle (minimum, most likely, maximum)	Sheep	Goats	Pigs	Buffaloes	Camels
Morbidity	(0.01, 0.0315, 0.08)	0.0155	0.0147	0.0142	0.0039	0.0039
Mortality	0.0730	0.0100	0.0100	0.0200	0.0100	0.0100
Weight loss	0.2380	0.1190	0.1190	0.1190	0.1190	0.1190
Hide loss	0.0730	0.0100	0.0100	0.0200	0.0100	0.0100
Milk loss	0.8000	0.4000	0.4000	0.4000	0.4000	0.4000

Source: Knight-Jones, T.J.D. & Rushton, J. 2013. The economic impacts of foot and mouth disease – what are they, how big are they and where do they occur? *Preventive Veterinary Medicine* 112(3–4): 161173; authors' assumptions.

A qualitative risk assessment was conducted following the detection of foot-and-mouth disease serotype SAT2 (FMD SAT2) in West Eurasia and the Near East in February 2023. Serotype SAT2 usually circulates only in Africa, and so most animals in the region are fully susceptible to infection by this virus. The likelihood of spread of the FMD SAT2 to unaffected countries via key risk pathways and the potential consequences of the FMD SAT2 incursion in the region were described and assessed.

Plausible pathways for the introduction of FMD SAT2 were identified for most countries. Informal movements of live animals and common grazing are the pathways of greatest concern because direct live animal contact is a very effective mode of FMD transmission, especially in the absence of sanitary measures. The large increase of animal movements associated with festivals such as Eid al-Adha, as well as seasonal grazing movements, increase the probability of FMD spread. An incursion of FMD SAT2 would result in a substantial negative impact, with the production losses and cost of control measures estimated at USD 3.6–6.5 billion, depending on the extent of spread within the region. Outbreaks of FMD also have a negative impact on food and nutrition security, economy, labour markets, and the livelihoods of most vulnerable people.

To mitigate the risks of FMD SAT2, all countries should have an emergency response plan for FMD that is realistic for the country and supported with adequate resources for implementation. A comprehensive list of preventive measures, including strengthened biosecurity and vaccination, is available in this document.

ISBN 978-92-5-138263-9

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CC8173EN/1/10.23