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Excluding Livestock Livelihoods in Refugee Responses: A Risk to Public Health

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The Syrian civil war caused a near total collapse of its health and veterinary infrastructure, affecting vaccinations, quarantine and border control. While outbreaks of zoonoses—diseases transmissible between animals and humans—in neighbouring countries are attributed to irregular cross-border movements, little remains known about the impact of conflict and displacement on livestock, and zoonotic disease risks in refugee and host populations. This case study investigates the role of livestock and zoonotic disease dynamics in the Syrian refugee context in Jordan, to inform policies and procedures for better inclusion of livestock in refugee responses. Key informant interviews were conducted with humanitarian, animal and public health experts, and household interviews with Jordanian and Syrian livestock keepers in Mafraq Governorate. Respondents attributed zoonotic disease outbreaks to cross-border smuggling of livestock, with no reports of refugees bringing animals into Jordan. While Syrian respondents diversify their livelihoods through animal husbandry, high-level political and practical barriers affect refugees' access to livestock assistance, increasing zoonotic disease risks. To support animal and human health, stakeholders need to address structural inequalities through inclusive policies and support to both refugees and host populations.

Keywords: Jordan, Syria, refugee health, zoonoses, livestock, livelihood

Introduction

The escalation of peaceful protests in Syria in 2011 into a complex multisided civil war caused widespread destruction and displacement. Over the past decade, an estimated 13 million Syrians fled their homes, roughly 60 per cent of the country's total population (OCHA 2021). Over 6.6 million crossed international borders, and Syrian nationals now constitute around a quarter of the total global refugee population, with the vast majority living in Syria's neighbouring countries Turkey, Lebanon and Jordan (World Bank 2020; OCHA 2021). Jordan hosts an estimated 1.3 million Syrian refugees, constituting around 7 per cent of

Jordan's total population, of which about half are formally registered with the United Nations Refugee Agency (UNHCR 2021). The majority arrived in Jordan between 2012 and 2015, after which borders were closed due to the spillover of violent conflict and terrorism concerns (Bellamy *et al.* 2017; Tobin *et al.* 2021).

Almost half of the Syrian refugee population within Jordan originates from Daraa Governorate, where many depended on agricultural livelihoods, including animal husbandry (FAO 2013; Tiltnes *et al.* 2019; World Bank 2020). Historically, animals play an important role in forced migration; however, livestock in displacement is seldom researched or included in refugee responses (White 2018; Braam *et al.* 2021a). While refugee movement itself is associated with an increase in infectious disease transmission, and livestock movement is likely to affect zoonotic disease risks, it therefore remains unclear how forced migration affects disease dynamics (Tarnas *et al.* 2021). Human and animal susceptibility to disease during forced migration might increase due to exhaustion, malnutrition and stress arising from displacement, exacerbated by crowded and substandard living conditions (Hammer *et al.* 2018). However, zoonotic disease risks depend on complex interacting drivers beyond the presence of pathogens, including political, socioeconomic and environmental factors, determining settlement location, livelihood options and access to services (Braam *et al.* 2021b). This study therefore addresses both the evidence gap on livestock in displacement, while investigating factors impacting zoonotic disease dynamics in refugee and host populations in Mafraq Governorate in Jordan.

Before the civil war, agriculture contributed around 21 per cent to Syria's Gross Domestic Product (GDP), with livestock contributing between 35 and 40 per cent to the total agricultural production, largely for export to Saudi Arabia and the Gulf States (FAO 2017; Enabbaladi 2019). The loss of public services in the highly centralized and subsidized sector, which included free vaccines, subsidized fodder and veterinary services, resulted in a rapid decline of the livestock sector (FAO 2017; Tull 2017). The subsector accounted for the highest proportion of damage in the war, as animals were killed, stolen or lost due to poor living conditions, while many livestock keepers were forced to sell animals (FAO 2017), affecting livelihoods, food and transportation (Tarnas *et al.* 2021). The Food and Agriculture Organization (FAO) estimated in 2017 that Syria lost almost half of its livestock since the start of the civil war (FAO 2017).

Jordan was a major importer and transit country for sheep from Syria until August 2012, when trade routes and border control were disrupted. Lapses in control were exploited by smuggling networks however (FAO 2013; Herbert 2014). Unvaccinated animals crossed illegally into Jordan (FAO 2014), with desperate Syrian livestock owners selling their animals to traders far below market value (Herbert 2014). Tens of thousands of sheep were smuggled across the border (Herbert 2014). This unregulated movement across borders is associated with outbreaks of animal diseases and zoonoses—diseases transmissible between animals and humans—in the region (UNHCR and MOP 2020), and an increase of zoonotic disease outbreaks was reported in Jordan between 2010 and 2013 (FAO 2014).

The arrival of over a million Syrians in Jordan increased pressure on already limited water, infrastructure, housing and job resources (Alrababa'h *et al.* 2021). In Mafraq Governorate, the number of Syrian refugees now nearly equals the number of Jordanian residents, adding pressure on healthcare and educational services (Miettunen and Shunnaq 2020). Initially housed in refugee camps, most refugees resettled elsewhere along tribal or kinship affiliations, hosted by Jordanian relatives and host populations which provide substantial support, with around 90 per cent now living outside refugee camps (Stave and Hillesund 2015; Miettunen and Shunnaq 2020; Tobin *et al.* 2021; Zuntz 2021a).

As ongoing conflict, the lack of economic and livelihood opportunities within Syria hampers the return of refugees, the humanitarian emergency in Jordan has become a protracted refugee situation (Ali 2021). Within Jordan, humanitarian assistance is decreasing however, necessitating refugees to diversify livelihoods and household income, including through livestock keeping. Faced with ownership limitations, non-Jordanians rarely register their livestock, and little is known about livestock numbers, husbandry practices and zoonotic disease risks. Syrian livestock keepers move within the margins of public and private land, and continue to be blamed for land degradation and other environmental issues in Mafraq (Alshoubaki and Harris 2018), as well as transboundary diseases, even though there is little primary evidence available (UNHCR and MOP 2020). As refugee and host populations share the livestock value chain within Jordan, these knowledge gaps need to be addressed to be able to better protect health and livelihoods of both communities. Although formal refugee responses are generally based on the differences between refugees and host populations, this study reflects on whether these differences are valid when considering zoonotic disease dynamics.

One suitable framework to uncover the complex linkages of political, socioeconomic, environmental and biological factors, and their impact on health outcomes along a spatiotemporal scale, is the ecosocial theory (Krieger 1994). Increased understanding of the multifaceted drivers of zoonotic disease beyond biomedical risk factors, resulted in the development of interdisciplinary theoretical frameworks and approaches such as One Health, Ecohealth and Planetary Health which consider the interlinkages of biological and environmental factors across human, animal and ecosystem health (Tasker and Braam 2021). While these frameworks provide important approaches to include determinants of health, such as the impact of the lack of nutrition, sanitation and substandard shelter in refugee contexts, this risk is rarely placed in a broader, geopolitical and historical context. Krieger developed the ecosocial theoretical framework to better contextualize the socioeconomic determinants of health, using an integrated approach to analyse multilevel drivers of disease. The theory includes a consideration of historical, political and socioeconomic developments, allowing for a comprehensive analysis of how disease distribution is influenced by the unequal distribution of power and resources, particularly relevant to refugee populations (Krieger 2001).

Krieger applies her theory to look at 'how discrimination, as one form of societal injustice, becomes embodied inequality and is manifested as health

inequities' (Krieger 2012). Patterns of morbidity and mortality are linked to inequities in political and socioeconomic conditions, which may be either exacerbated or mitigated by external factors such as policies and social infrastructure (Castañeda *et al*. 2015). Using this framework, I analyse the multilevel internal and external policies and the humanitarian aid framework in relation to local, community, and household drivers to disease, contributing to the interdisciplinary literature of the role of livestock refugee livelihoods and health, with the aim to enhance inclusive policies and responses to livelihoods, veterinary and public health in refugee contexts.

Methodology

Using a case study methodology (Yin 2003), qualitative data were collected through semi-structured interviews with key informant and household interviews, and community observations in March 2020. Fieldwork was supported by a review of available secondary qualitative and quantitative data on refugee demographics and zoonotic disease, drawn from open and subscription databases, or collected during interviews. Within this study, the term 'refugee' is used for all Syrian displaced, whether or not registered with the United Nations refugee agency (UNHCR): those who were displaced across the border, or could not return, and remain in Jordan informally because of the Syrian conflict, as well as their children (Tiltnes *et al*. 2019). The Jordanian population is considered the 'host' population to the refugees.

Study area and participants

Mafraq Governorate is located in northeast Jordan, bordering Syria, Iraq and Saudi Arabia. The Governorate has an estimated population of 300,000 Jordanians (2012) and 25 per cent (165,000) of the total number of registered refugees in Jordan, with an unknown number of unregistered migrants and asylum seekers (UNHCR 2021). Mafraq is host to Zaatari refugee camp, which remains one of the largest in the world with around 80,000 inhabitants in 2021 (UNHCR 2021). Poverty prevalence among the Jordanian host population in Mafraq is high at 23 per cent (FAO 2013), while almost all refugee households live below the official poverty line of USD 96 per individual per month (Thiombiano 2017).

While Mafraq is the second largest out of Jordan's 12 governorates, it is the least densely populated, as it includes a significant part of the *Badia*, the arid region covering around 80 per cent of the country (Al-Tabini *et al*. 2012). While 70 per cent of its population is considered rural, the contribution of the national agriculture sector to Jordanian GDP is low due to the limited availability of water (less than 3 per cent) with livestock contributing 58 per cent to the sector (Awawdeh *et al*. 2000; Thiombiano 2017). The agriculture sector employs around 10 per cent of the working age population (aged 16–64), including 70 per cent women, dominated by non-Jordanians (Thiombiano 2017). Sheep and goat milk provide important nutrition to poor households in the region, with sheep

contributing almost one-third of locally produced milk (Mercy Corps 2017). Sheep and goats are primarily kept in semi-intensive systems, depending on rangeland grazing, with significant 'backyard' husbandry, sometimes including cattle (Awawdeh *et al.* 2000).

Sharing a livestock value chain and open grazing areas, both Jordanian and Syrian livestock keepers in Mafraq Governorate were selected for semi-structured household interviews and observational studies using purposeful, maximum-variation sampling (Patton 2015), by selecting households across husbandry systems: medium to large herds (n $\geq$ 100 livestock), smallholder (rural/informal tented settlements or ITS) and backyard farmers (village). A total of 14 household interviews were conducted, using semi-structured questionnaires focusing on respondents' socioeconomic characteristics, experiences of displacement, human and animal health and health-seeking practices (Figure 1).

In addition, 14 individuals were selected for semi-structured key informant interviews through purposive and respondent-driven sampling based on their technical and interpretive knowledge and expertise in public health, veterinary health and/or the Jordanian refugee response in Amman, Irbid and Mafraq. The semi-structured interviews collected information on the key informant's role and experience in their field related to the Syrian refugee response, their views on veterinary public health and risk areas of zoonotic disease transmission.

Data collection

Fieldwork was conducted in March 2020 in English and Arabic by the author supported by a Jordanian research assistant, a resident of Zaatari village. Interviews were recorded after approval from the respondents, and subsequently

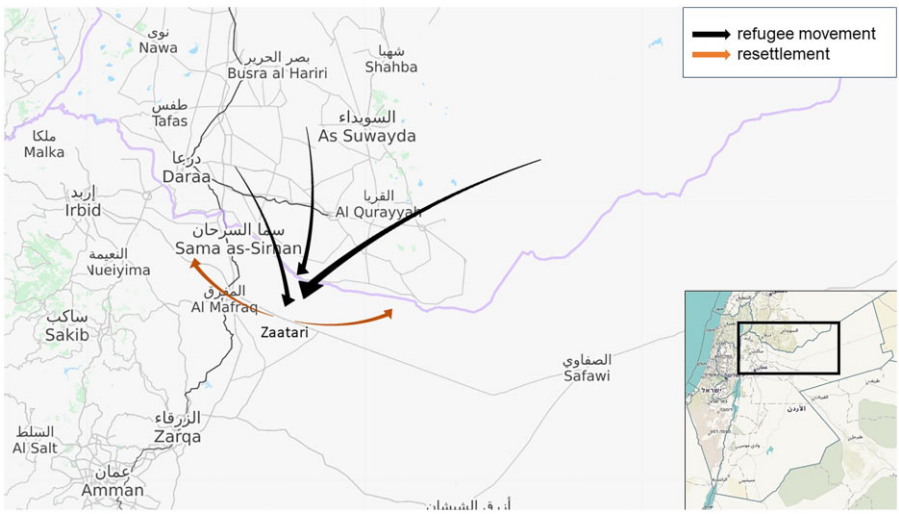

Figure 1.
Location of fieldwork in Jordan and refugee movements (adapted from *Open Street Map*).

translated and transcribed by an independent transcriber. Observations within and around the household and community were recorded using field notes and photos, and analysed to contextualize and triangulate interview responses. To strengthen the validity and reliability of data, responses were regularly checked with participants (Merriam 1998).

Ethical considerations

The study protocol was approved by the Human Biology Ethics Committee at the University of Cambridge (protocol number HBREC.2019.25), and approved and facilitated in Jordan by the International Fund for Agricultural Development (IFAD) within the Ministry of Agriculture. Copies of the study protocol and informed consent letters shared with participants upon request. Participants were informed about the study during face-to-face, telephone and/or e-mail recruitment, and informed about the voluntary bases of participation and their right to withdraw prior or during data collection. All participants gave verbal consent for data collection and recording of interviews. Participants' anonymity was ensured by full anonymization in the analysis and discussion to remove any personal identifiable information.

Data analysis

Data analysis was conducted manually in English, using a thematical analysis approach (Attride-Stirling 2001). Findings were coded based on themes constructed during data collection and analysis and synthesized into matrices, and triangulated with primary and secondary data (Attride-Stirling 2001). Study findings were interpreted using concepts from the ecosocial theoretical framework to analyse the multilevel factors, dynamic processes and pathways affecting zoonotic disease risk among refugee and host populations (Krieger 2012). The results and discussion section below is structured along the global themes constructed during the study, based on the perspectives from self-settled refugees and their hosts in Mafraq.

Results

Movement and loss

Reflecting the high levels of forced migration during the early years of the civil war, all Syrian respondents arrived in Jordan before 2014, from Daraa, Hama or Homs Governorates, leaving their homes, land and possessions, as the war escalated in multisided conflict and subsequent rise of violent extremist groups (FAO 2014; IDMC 2021). Two households lost all their livestock in the conflict, while other herds were stolen or seized by the army or militant groups, and weakened animals were lost to starvation and disease. Some households left part of their herd with family members in Syria, and those who still owned livestock at the time of initial displacement sold their animals in stages to middle men and traders, obtaining cash to buy food, shelter and pay for onward transportation.

> In Syria I owned 100 animals, [the sheep and goats] were all killed by a bomb. In Homs our house had three rooms, a living room and a guest hall. Our house [and all our belongings] were destroyed and we escaped from death to Jordan on 27 September 2013. (Male Syrian smallholder from Homs, Zaatari village)

> [I am] from [rural] Hama [where] my family owned about one thousand sheep. We lost about half of them in the war [selling them to cover costs], the rest is still with my family in Hama. I have had no contact with [the family in Syria] since I got here in 2011. (Male Syrian livestock worker from Hama, rural Mafraq)

Displacement routes and destinations largely depended on kinship, linguistic and tribal affiliations, trading and employer relationships, which facilitated movement out of Syria and protection within Jordan (Tobin *et al.* 2021). While some refugees moved directly into rented houses in relatives' villages, most respondents spent the first days after arrival in Zaatari refugee camp, where many felt uncomfortable due to inadequate shelter, sanitation and health services, safety and privacy concerns, as they had to 'live among strangers' (male Syrian farm worker, rural Mafraq). Initially smugglers helped refugees to leave the camp, while in 2014 and 2015 refugees could leave the camp through the formal pathway of 'sponsorship', a system whereby a Jordanian guarantor enabled Syrians to resettle elsewhere within Jordan, a program suspended after 2 years (Bellamy *et al.* 2017). Social networks often already existed before displacement (Thiombiano 2017), and considering the cultural similarities of Syrians and Jordanians, most refugees needed little social adaptation (Miettunen and Shunnaq 2020).

> The relationship between Syrians and Jordanians (...) is very good [we have] the same culture, [the] same mind. (Male Jordan smallholder, Zaatari village)

> Jordan is like Syria, same people, same food, same language, same everything. (Male Syrian livestock trader, Mafraq/Amman)

Syrian respondents lived across urban and rural areas, in rented accommodation, empty houses provided by the host community or ITS. Those who worked as seasonal labour migrant on Jordanian farms prior to the civil war were allowed to remain in ITS by the Jordanian farm owners, while others are now permanently employed as herders, housed in poor accommodation with limited access to basic services (Thiombiano 2017). Many brought their families over following the outbreak of war, with women mainly responsible for household work, raising children and tending livestock (FAO 2013; Miettunen and Shunnaq 2020).

While the risk of hostility between host community and refugees over jobs, resources, housing and services is regularly highlighted by researchers (Achilli 2015; Alshoubaki and Harris 2018; Miettunen and Shunnaq 2020; UNHCR and MOP 2020), recent studies suggest that relationships between refugees and host communities are more nuanced (Al-Mahaidi 2021; Alrababa'h *et al.* 2021). Alrababa'h *et al.* found that host populations had an overall positive attitudes towards refugees through their close tribal, religious and kinship ties, with social

bonds playing an important role at community level (Alrababa'h *et al.* 2021). While Stevens (2016) found that over the years of civil war, social networks among Syrian refugees in urban areas collapsed under financial and emotional burden of prolonged displacement (Stevens 2016), the current study found strong ongoing mutual support between Syrians, as well as between host community and refugees, which might reflect the characteristics of rural communities, and pre-existing labour migration patterns, highlighting the complex social dynamics in the refugee context (Lokot 2020).

Local and regional associations support integration of refugees and host communities, founded by both Jordanians and resident Syrians, and refugees are supported by employers, neighbours and relatives, based on kinship, cultural or religious duty and solidarity (Chatty 2017). One respondent received five goats from neighbours in Zaatari village, who further support the family with free shelter, water and electricity, while leftover feed for the goats is provided daily by a nearby restaurant. Agricultural workers in ITS receive electricity from solar panels installed by the Jordanian farm owner, and supplement their income by borrowing money from neighbours. Another family borrowed money from other livestock owners to buy sheep for their herd. McNatt *et al.* (2019) noted that during health emergencies host community members actively supported refugee neighbours (McNatt *et al.* 2019). Despite respondents showing their gratitude to their Jordanian hosts, a study by Tobin *et al.* (2021) showed that about half of Syrian refugees considers their economic situation in Jordan 'much worse' than in Syria (Tobin *et al.* 2021).

Connected livelihoods

The political and institutional environment in Jordan for Syrian refugees is complex, varying across sectoral stakeholders with different objectives and responses at national and local level (Ali 2021). Although Jordan is not a signatory to the 1951 Refugee Convention or its 1967 Protocol, the country provides protection and asylum to political refugees and UN-approved foreigners under a 1998 Memorandum of Understanding with UNHCR, and Syrians registered with UNHCR are provided with an asylum seeker certificate, and biometric residency permits to access temporary livelihoods and education (Tobin *et al.* 2021). The government rejects the UNHCR terminology of 'refugee', instead using 'guests', and formally allows refugees to reside in Jordan for 6 months or 'until a lasting solution is found', resulting in an ambiguous legal framework (Bellamy *et al.* 2017).

Current humanitarian assistance provided to refugees in Jordan is insufficient and inadequate (Tobin *et al.* 2021). Registered refugees receive some assistance from international organizations, including targeted cash assistance and food vouchers (Thiombiano 2017; World Bank 2020); however, respondents identified a lack of resources to buy nutritious food, feed for livestock and fuel as some of their primary concerns, with studies showing high levels of food insecurity (Tiltnes *et al.* 2019), with as much as up to half of refugees consuming sub-optimal diets

(REACH 2020). Between 2015 and 2019, UNHCR reduced its spending with US$25 million, and respondents witnessed the reduction, and sometimes complete removal, of sanitation, education, mobile healthcare, clothing and other support programs and items (Small 2020). Syrian refugees now depend on a combination of (irregular) daily labour, taking out loans or borrowing money, and cash assistance for their livelihood (Tiltnes *et al.* 2019; REACH 2020).

Prior to the war, Syrians were permitted reciprocal freedom of entry, movement and work under a bilateral treaty, which was extensively used by Syrian seasonal agricultural workers (Bellamy *et al.* 2017; Zuntz 2021a), many of whom remained in Jordan after the outbreak of civil war (FAO 2013; Stave and Hillesund 2015; Mercy Corps 2017; Thiombiano 2017; World Bank 2020). Many remain working illegally in an already substantial informal labour market, lacking documentation and facing increased risk of deportation (Bellamy *et al.* 2017), with agricultural workers often lacking formal work contracts, labour rights and social security (Tiltnes *et al.* 2019; IRC 2020). Some of these issues are related to the use of intermediaries to find agricultural jobs by many Syrians (Zuntz 2021b); however, respondents in this study had been working with their Jordanian employers for several years before becoming refugees.

The European Commission (EC) signed the 2016 Jordan Compact with the Government of Jordan to increase access of Syrian refugees to formal work permits in return for financial support to the Government of Jordan (Barbelet *et al.* 2018). To protect local employment, work permits are only provided in sectors where refugees are considered not to compete with Jordanians (Bellamy *et al.* 2017). The Compact has been criticized for highlighting the artificial divide in refugee versus labour migration responses, failing to contextualize the realities of the existing labour market dynamics in Jordan (Lenner and Turner 2019; Gordon 2021). Work permits remain difficult to obtain by refugees due to gatekeepers, including NGOs and employers in the agricultural sector, and only one-third of Syrian refugees held a valid work permit in 2020 (Stave and Hillesund 2015). Other obstacles include a lack of resources available for administration and transportation fees during the application process, with most permits ending up with those living in camps (IRC 2020; Tobin *et al.* 2021). Some refugees opt out of the scheme altogether, as they fear losing humanitarian assistance once obtaining formal employment (Mercy Corps 2017; Wake and Barbelet 2020).

> [Our family] owned 10,000–15,000 sheep [to] truck from Syria to Saudi or Emirates or Kuwait. [My uncle] sold all of them for money for the family to leave Syria. I [now] buy sheep [to trade] with money from my friend (a trusted family connection) in Saudi Arabia through Hawala, using a Jordanian [partner's] name. Sometimes [I have to wait] 3 to 4 months for money. I cannot drive my car because of the [lack of a] license. I can get a work permit, but I do not want it. (Male Syrian livestock trader, Mafraq/Amman)

In Mafraq, almost a third of Syrian refugees now diversify their income through livestock keeping out of necessity (Thiombiano 2017). Respondents keep small

herds of sheep, goats and cattle in improvised shelters near their homes for dairy production to supplement their daily food rations, sporadically selling surplus to local shops. While the average number of small ruminant herds varies from 3 to 54 (Thiombiano 2017), one Syrian respondent managed to expand their herd through breeding to 150 sheep in the past 8 years, close to what they owned in Syria before the war. One Jordanian respondent claimed that 'Syrian livestock ownership affects Jordanian livelihoods', including through an increase in fodder prices, although he was not affected directly (Jordanian male farmer, Mafraq). In fact, as informal border trade had previously benefitted Jordanian farmers in the border region, through access to Syrian government subsidies and inexpensive animal feed, the civil war mainly impacted Jordanian livestock keepers financially (FAO 2014; Mercy Corps 2017). To address the economic challenges of local host communities, the Jordanian government now requires humanitarian stakeholders to include at least 30 per cent Jordanians in any support provided to refugees (Bellamy *et al*. 2017).

While closely interlinked, refugee livelihoods remain fundamentally different than that of the Jordanian host population (Jacobsen 2014; Betts *et al*. 2017). There are legal limitations for non-Jordanians on the ownership of natural and physical resources, including livestock keeping for commercial purposes. Limitations include minimum cash investment requirements or a Jordanian legal partner, with applicants either discouraged from applying or refused by authorities following an opaque process (Bellamy *et al*. 2017). While non-Jordanians are in principle allowed to operate unregistered dairy farms with fewer than 20 cows or 100 sheep or goats, larger herds need to be registered and provided with minimum space and hygiene standards set by the Ministry of Agriculture (Mercy Corps 2017). As these conditions are challenging for refugees to meet, in addition to the inability to register livestock, refugees lack access to the free vaccinations and subsidized feed provided by the Ministry of Agriculture (Mercy Corps 2017).

A Jordanian government official claimed that less than 1 per cent of livestock in Irbid Governorate was owned by Syrians, because: 'if a Syrian would buy animals, we would know, as they buy from local farmers' (male Jordanian government official in Irbid), this statement was contradicted by almost all Jordanian and Syrian livestock keepers, who reported that herds were expanded through breeding the herd, rather than through buying animals. The lack of legal clarity and conditions for registration was reflected in our study, with most respondents unaware that refugees are allowed to own livestock for subsistence (Thiombiano 2017). Only one Syrian respondent managed to register their animals through a Jordanian relative.

> I [do not have] a national number and [my] livestock is recorded by my cousin from Jordan. I can't register my house or the car, we are not even allowed to put money in the bank, [everything is] registered in other people's names. There was law [in Jordan] that after 15 years [allowed us to] apply for citizenship, but after the war in Syria this stopped. (Male Syrian large herd owner, rural Mafraq)

Vulnerability to disease

Following the widespread destruction of public services and infrastructure during the conflict, the World Health Organization (WHO) estimates that over one-third of hospitals in Syria is no longer functional, through destruction or due to a lack of staff and supplies (Tarnas *et al.* 2021), with the veterinary sector similarly affected. Interrupted vaccination programs, poor sanitation and living conditions, exacerbated the risk of infectious diseases, resulting in outbreaks of typhoid, polio and the zoonosis leishmaniasis in Syria (Mosleh *et al.* 2018). The collapse of quarantine, lack of vaccinations and border control increased the risk of regional disease transmission (Herbert 2014; Tull 2017), and were highlighted as prime concerns for human and animal health in the region by Jordanian respondents.

> [Animal] diseases impacted Jordanian [livestock] owners. A lot of sheep crossed the border illegally by smugglers, and the price of our animals went down. (Male Jordanian large herd owner, rural Mafraq)

Animal disease outbreaks of Lumpy Skin Disease (LSD), Foot and Mouth Disease (FMD), Peste des Petits Ruminants (PPR) and zoonoses including leishmaniasis, rabies, influenza, parasites, Rickettsia and coronaviruses were reported in Mafraq Governorate near the Syrian border in the early years after the outbreak of civil war (FAO 2014). While linked to irregular border crossings, respondents associated endemic zoonotic disease outbreaks among livestock to smuggling rather than refugee movement, having 'never heard of Syrians moving with their livestock' (female Syrian herd owner from Daraa, rural Mafraq), which confirmed reports from humanitarian organizations that Syrian refugees did not bring livestock through formal border crossings (Thiombiano 2017).

> [We] had about 150 sheep in Homs for meat, wool and milk. [Before the war] we received free yearly vaccinations, some subsidized medicines and subsidized feed. We sold all sheep to traders [as we were] not allowed to bring them to Jordan. (Male Syrian livestock shareholder from Homs, Zaatari village)

In Jordan, the Ministry of Agriculture is responsible for animal health and veterinary services, through its Secretary General Assistant for Livestock and Chief Veterinary Officer (CVO) (Sorrell *et al.* 2015). International actors also play an important role in Jordanian veterinary public health. For instance, the Ministry of Agriculture zoonotic disease prioritization exercise focused on regional food security and health in the Middle East Region, led by the UN Food and Agricultural Organization (FAO) and the US CDC, primarily focusing on trade (Sorrell *et al.* 2015; USDA 2016). Governorate level veterinary directorates provide free veterinary services, including vaccinations to registered sheep and goats of FMD, PPR, sheep- and goat pox, Brucellosis and Anthrax (USDA 2016). Jordanian livestock keepers can choose three of these, with most opting for FMD, PPR, pox or anthrax, as the Brucellosis vaccine is linked to abortions; however, these are not accessible to Syrian respondents as they do not register their livestock.

The lack of oversight on refugees' husbandry practices and dairy businesses as a result of exclusive policies and practices is considered a community health risk by some humanitarian responders (Mercy Corps 2017), particularly driven by smallholders with limited to no prior experience handling livestock or livestock products, 'lacking [husbandry] education' (male veterinary academic, Irbid). Challenging living conditions and the lack of water complicates hygienic husbandry practices, and we observed how small and large ruminants are often kept together, with no or limited separation (Obaidat *et al.* 2018). Meanwhile sick animals are freely traded: a Syrian respondent recently lost hundreds of lambs he meant to sell onto Saudi Arabia to an unidentified disease, as veterinarians could not find the cause in the 12 carcasses provided for post-mortem. Medication is easily purchased over the counter, including antimicrobials without a veterinary prescription and antimicrobial and multidrug resistance in Jordan is rife, with increasing risks to animal and human health (Obaidat *et al.* 2018).

Jordanian respondents complained that veterinarians in the public sector often do not have vaccines available, are slow in registering and vaccinating new animals and do not work over the weekend, with all respondents using private sector facilities instead. As access to free vaccines is a lengthy process, and subsidized fodder can only be collected after vaccination from the Ministry of Agriculture governorate office, many Jordanian livestock keepers also opt out from registering their animals (FAO 2014; Mercy Corps 2017).

> If I depend on government [registration] I cannot grow my herd. I have been waiting 4 years for [the government] to come and inspect and number [the sheep] but no one comes. (Male Jordanian large herd owner, rural Mafraq)

Among both Syrian and Jordanian respondents, the combination of a lack of livestock registration and vaccine hesitancy means that vaccination rates remain low, and cattle do not receive any vaccines in national control programs (Musallam *et al.* 2015; Sorrell *et al.* 2015). Meanwhile the prevalence of endemic zoonoses in Jordan such as brucellosis is high (18 and 35 per cent prevalence in cattle and small ruminant herds, respectively); however, there is little formal response to these diseases, as the government lacks funding for medication and compensation for slaughter (Musallam *et al.* 2015). Other gaps in veterinary public health are the absence of effective surveillance system, lack of early detection of animal diseases by farmers and technicians and the lack of effective control strategies and materials such as tests and diagnostic capacity (USDA 2016). While veterinary drugs are generally available and affordable, farmers perceive the quality to be inconsistent, which was reflected in the study (Mercy Corps 2017).

> [medication] from Belgium is very good, from Jordan good, from China not bad, but from England very bad. (Male Syrian large herd owner, rural Mafraq).

Poor livestock health is a risk to the health of both Syrian and Jordanian host communities. While Jordan has one of the most advanced and well-resourced

health care systems in the region, with over 4 per cent of GDP spending on public health (Dator *et al.* 2018; UNHCR and MOP 2020), and most of Jordan's population covered by health insurance (WHO 2006), access to health services is not equal for Syrian refugees. This is both attributed to a lack of resources (McNatt *et al.* 2019), and awareness of available services (Dator *et al.* 2018). While refugees can access free healthcare and vaccinations in NGO clinics in the district where they are registered with UNHCR, initially refugee registration was only possible in Amman, with only those who have successfully re-registered accessing services in Mafraq. If hospitalization is required, Syrians need to pay the subsidized rate for non-insured Jordanians, costs which many Syrian respondents considered too high, especially in combination with the required transport (REACH 2020; UNHCR and MOP 2020), and refugees only visit clinics when their 'suffering becomes too much' (Jordan paediatrician in Amman).

> Health was good in Syria, really, really good. Here [there are many] problems. (Male Syrian trader, Mafraq/Amman).

Almost half of Syrians in Jordan live in households with high to severe health vulnerabilities, including 31 per cent with pre-existing medical conditions and 11 per cent suffering from chronic disease (UNHCR and MOP 2020). Refugees' ill health may be caused or exacerbated by trauma, stress and challenging living conditions (McNatt *et al.* 2019), as observed in the ITS and those Syrian refugees herding livestock for Jordanian owners participating in this study. According to the ecosocial theory, social injustice and structural violence through the denial of political and civil human rights creates unsafe, unhygienic living conditions and livelihoods, resulting in increased contact with infectious agents (Krieger 1999). This is reflected in the disproportionally high prevalence of infectious diseases with (potential) zoonotic origins among Syrian refugees, such as tuberculosis and cutaneous leishmaniasis (Doocy *et al.* 2016; Boyd *et al.* 2019). The exact burden of disease remains largely undetected however, related to gaps in active surveillance and challenges in data collection in remote areas, with the majority of vulnerable out-of-reach refugee populations living in Mafraq (Doocy *et al.* 2016; REACH 2020; UNHCR and MOP 2020).

Health literacy and education are important determinants of health among migrants (IOM *et al.* 2013). In Jordan, education to Syrian refugees is primarily provided in double-shift schools, whereby classes are delivered to Jordanian students in the morning and Syrian students in the afternoon, which already existed before the influx of refugees (Small 2020), with mixed effectiveness (Barbelet *et al.* 2018). Private schools are available for those with resources, but largely out of reach for poor refugees (Tobin *et al.* 2021). Only 56 per cent of school age refugee children attend school (Tobin *et al.* 2021). While primary school attendance among Syrian children is 86.6 per cent, only 25–30 per cent attend secondary education (Small 2020; UNHCR and MOP 2020), However, many refugee parents see limited benefit to their children obtaining an education as only unskilled labour is available (Small 2020), and school attendance among Syrian

respondents' children was limited to primary school (Thiombiano 2017; Barbelet *et al.* 2018; REACH 2020).

In March 2018, UNHCR and the Government of Jordan started a regularization campaign to regularize all Syrians within the country's borders, aimed to improve access to services, including health and education, and protection status of unregistered refugees (Tobin *et al.* 2021). Without a comprehensive legal protection framework however, there remains risk of discrimination or exploitation, ultimately impacting animal and human health. Meanwhile, a safe return to Syria is unlikely in the short term without improved security and socioeconomic conditions, access to property and assets and the availability of key services (World Bank 2020; Tobin *et al.* 2021), highlighting the need for inclusive responses to health and livelihoods within Jordan.

> [our situation] is better in Jordan, we will not go back [to Syria], we have no place there.
> (Male Syrian smallholder from Homs, Zaatari village)

Limitations

As all Syrian refugees moved to Jordan over 8 years ago, some recall bias can be expected, in particular when discussing displacement experiences. Logistical and pandemic challenges did not allow the researcher to travel to remote areas, introducing some bias in terms of a relatively uniform respondent population, which are at most two links removed from IFAD/MoA and/or its connections.

Conclusion

This study shows that zoonotic disease outbreaks in Jordan are primarily associated to the collapse of Syria's veterinary services, quarantine and border control during the civil war, and resulting cross-border smuggling of livestock. Animals sold within Syria by displaced livestock keepers to middlemen and smugglers, ended up in the Jordanian market without quarantine and vaccinations. What happened to the Syrian livestock within Jordan remains largely unknown, with zoonotic and other animal disease risks for stakeholders along the value chain, including the Jordanian host population.

While refugee movements are indicated in disease outbreaks, the study shows no evidence of refugees bringing along livestock, as these were all lost before crossing the borders. After arriving with few or no possessions, faced with livelihood restrictions in Jordan, Syrian refugees became greatly dependent on external aid. Much of the refugees' daily needs and emergency assistance is provided by Jordanian host communities. Over the past decade official humanitarian assistance to refugees has decreased, and livestock keeping was adopted by many as livelihood strategy, including by those without prior experience or knowledge of animal husbandry. Some Syrian respondents were able to buy sheep or goats, subsequently gradually expanding their herds through breeding. Others, including

many pre-war seasonal labour migrants, became permanently settled in ITS, with their livestock smallholding tolerated by the Jordanian farm owners. Their risk of zoonotic disease risk is relatively high, living on marginal land, in substandard housing close to their animals, circumstances which exacerbate the spread of infectious diseases.

Refugee livestock is structurally excluded from agriculture and veterinary support provided by authorities and humanitarian agencies however. The risk of zoonotic disease within Jordan is therefore determined primarily by exclusive policies, and the lack of support for sustainable livestock keeping among the refugee population. The ecosocial theory provides a useful framework to reflect on the impact of these political and institutional barriers in Jordan on human and animal health, as a result of unequal access of refugees to quality veterinary and health services, through the restrictive conditions on livestock ownership and registration. All Syrian refugee livestock keepers face systemic gaps and barriers, resulting in structural discrimination and social injustice, as they are unable to formally register their livestock, and as a result lack access to free vaccinations and subsidized feed. This exclusion negatively impacts animal health, increasing vulnerability to animal disease and zoonoses. While largely neglected by authorities and humanitarian responders, livestock based livelihoods are informally facilitated by Jordanian host communities, and refugees' livestock is fully integrated in local supply chains, with animals and livestock products informally traded and shared between refugees and host populations.

As return to Syria is increasingly unlikely for many refugees, their livelihoods need better and more sustainable support, importantly through formalizing livestock ownership and providing veterinary services and livestock support. Policy makers and humanitarian responders need to develop inclusive policies and procedures for consideration of livestock in the refugee response. Considering the importance of host population support to refugees, there is a strong argument to include them in policies and programs, tying in with the global trend towards localization. In principle, the Jordan Compact provides for increased assistance outside formal refugee settings, while the most recent Humanitarian Response Plan includes long-term support to local services, taking into consideration the impact on vulnerable Jordanian host populations; however, these guidelines need to be supported through enabling legal frameworks and sufficient direct funding.

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Conflict of interest

The authors declares no competing financial, personal, or professional interests that could be construed to have influenced the work.

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