



One Health approach recommended in investigating and communicating the potential role of pigs in transmitting Ebola in Uganda

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Executive summary

Zoonotic diseases are most dangerous when they take animal and human health workers by surprise, giving the public and disease control officials no advance warning or time to put prevention measures in place. The recent Ebola outbreak in West Africa illustrates the adverse consequences of trying to tackle a disease outbreak too late and with little information.

Ebola is a serious but mysterious disease; in Uganda, there is little solid information on the reservoir and transmission of Ebola. However, research findings in the last few decades have given rise to speculation that there could be associations between pigs and Ebola.

Currently, there is no evidence that pigs have had any role in past outbreaks of Ebola virus disease. But given the huge importance of pigs to the Ugandan economy, diet and livelihoods, it is important to investigate any potential links sooner rather than later.

A recent study by the International Livestock Research Institute (ILRI) argues there are several factors that support the potential role of pigs in the transmission of Ebola to humans in Uganda. It is critical that this hypothesis be investigated in order to understand the risks to the country's burgeoning pig production industry.

A spatial representation of potential risk factors for zoonotic transmission involving pigs in Uganda could be used to initiate further investigations into Ebola and other zoonotic diseases known to affect pigs in Uganda.

The researchers call for a One Health approach to the continued research. The benefit of this multidisciplinary approach is that limited resources can be utilized efficiently to improve the health and livelihoods of Ugandans through enhanced food safety and security, and the preservation of important ecosystem services, such as those provided by bats and other wildlife.

Clear and consistent risk communication from all research partners will be of utmost importance in preventing hysteria and delivering good outcomes for wildlife conservation and livelihoods.

Introduction

Working closely with partner organizations in Uganda, ILRI undertakes research on several pig diseases to help determine the country's disease risks and the best measures for protecting Uganda's public health and important pig industry. These include zoonotic diseases, which appear first in animals and then spread to people, often without much warning and with widespread and devastating consequences for local communities and authorities. Ebola is among several animal-to-human diseases being investigated.

A new risk assessment paper, *Assessing the potential role of pigs in the epidemiology of the Ebola virus in Uganda*¹, was published in the journal *Transboundary and Emerging Diseases* on 27 August 2015. Presently, there is no solid evidence that pigs have had any role in past outbreaks of

the Ebola virus disease. However, pigs are often a source of human disease, and the rapidly growing pig industry in Uganda is important to the livelihoods and diets of many poor households.

More than 1.1 million poor households in Uganda own pigs, mostly managed by women and children in backyard activities. Indeed, 80% of pig production in Uganda is carried out by smallholder crop-livestock farmers. Despite this dependence on livestock, there is a strong association between poverty, hunger, livestock keeping and zoonoses.²

The combination of large and rapid pig sector growth, supported by development programs and potential Ebola virus risk, prompted a foresight study to understand the possible risk pigs may present in Uganda.

The study found several important facts and observations about the Ebola outbreaks in Uganda that support the need to further investigate the role that pigs in particular play in the mysterious epidemiology of this disease. A risk map depicts high-risk areas due to a spatial overlap of three proposed risk factors for zoonotic Ebola virus transmission in Uganda. This might be used as an initial tool to conduct targeted and multidisciplinary investigations into the reservoir(s) and ecology of Ebola virus, which currently remain largely unknown.

Approach

The study used desk research, interviews and spatial analysis to understand the potential risk of zoonotic transmission from pigs in Uganda. A comprehensive review of relevant articles in the grey and published literature was undertaken to determine what is known about Ebola in pigs in Uganda and wider endemic regions. This was accompanied by expert interviews focused on interactions of domestic pigs with wildlife in different regions of Uganda. Finally, a risk map investigating the spatial overlap of potential factors supporting the spillover of the Ebola virus from animals to humans was conducted. These include the latest modelled zoonotic niche for Ebola³, domestic pig distribution and high numbers of people living in extreme poverty.

Results

The study identified the following facts and factors that support the potential zoonotic transmission of Ebola from pigs in Uganda:

- Fruit and insectivorous bats that roost in trees and human dwellings are putative yet so far unproven reservoirs of Ebola virus in Africa⁴. The evidence is particularly lacking in Uganda. It is possible that bats are intermediate hosts occasionally exposed via another intermediate host or unknown reservoir.
- A number of human Ebola index cases are unable to account for their source of infection, particularly in Uganda.
- Pigs are the only domestic livestock species presently known to be naturally infected with Ebola viruses⁵.
- The overlapping of Uganda's domestic pig habitat with environments suitable for the Ebola virus. Uganda's expanding pig populations, particularly those reared under free-range systems, overlap with habitats shared with potential wildlife sources of the Ebola virus. Pigs scavenging for food can thus come in contact with the dropped fruit, excrement, saliva, urine and faeces of infected wildlife.
- Reported interactions at the human-pig-wildlife interface could support transmission, perhaps, bats and pigs consuming the same fruits and chimpanzees hunting bush pigs.
- The possibility of Ebola virus infections in pigs going undetected in Uganda due to their being mistaken for African swine fever and other common pig infections causing similar symptoms. Furthermore, common practices in Uganda such as selling off sick pigs and consuming meat from pigs that have died of unknown causes could help spread an outbreak of Ebola virus in pigs and increase the risk of the virus spilling over to humans.
- Outbreaks of Ebola in people in Uganda are correlated with periods of peak pork consumption, such as during festivals, and anecdotal accounts have been reported of widespread pig deaths before outbreaks of Ebola in humans⁶, although the cause of these pig deaths has not been ascertained.

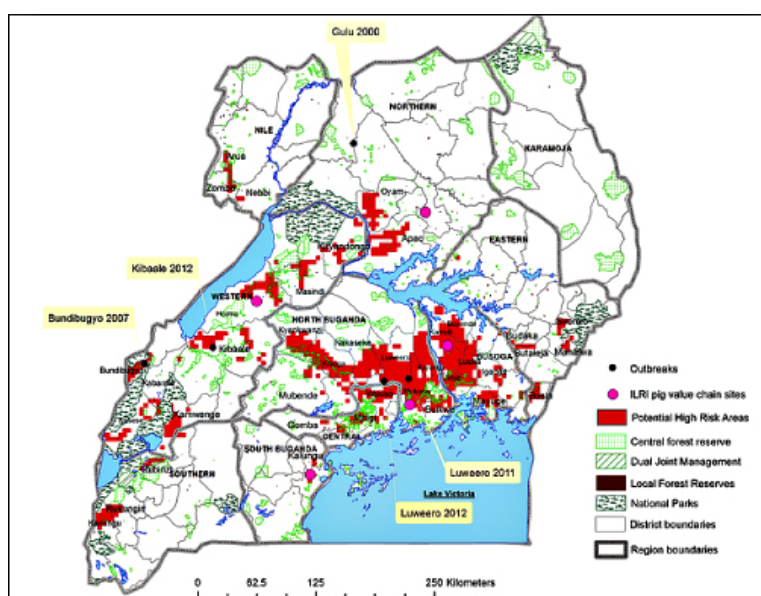


Figure 1: High-risk areas according to the spatial overlap of three proposed risk factors for zoonotic Ebola virus transmission in Uganda: modelled potential distribution, domestic pig distribution and high numbers of people living in extreme poverty.

Figure 1 shows the hypothetical areas of high risk as defined by Ebola virus potential distribution, pig production and high numbers of people living in poverty. The red areas reflect the spatial overlap of these hypothesized risk factors. They do not indicate the actual likelihood of a zoonotic spillover event. Interestingly, potential high-risk areas are found predominantly in the West and Central regions of Uganda, which fits with past locations of Ebola outbreaks in the country. There are flaws in the map, considering the incomplete understanding of Ebola host ecology and risk conditions, such as seasonal ecological events and behavioural associations with poverty, occupation and gender.

The importance of both pigs and bats for human livelihoods

The risk assessment paper considered a number of animal species which have been associated with Ebola, including domestic pigs and bats. Pigs provide important benefits for farmers, the economy and consumers in Uganda. Supporting the pig industry in Uganda is vital for reducing poverty and improving nutrition. Bats also provide essential ecosystem services, including pollination, seed dispersal and insect pest reduction. These invaluable services affect people directly and indirectly, thereby supporting local livelihoods and healthy ecosystems. Because of the many benefits from keeping pigs and the many services provided by bats, it is important that risk assessment and risk management should not jeopardize these.

For more information on smallholder pig keeping in Uganda, visit <http://livestockfish.cgiar.org/focus/uganda>

For a position statement by Bat Conservation Africa, visit <http://www.batconafrika.net/bats-and-ebola>

Conclusions

Further research on the role pigs may play in Ebola virus transmission in Uganda is warranted, even though there is no solid evidence that pigs have had any role in past outbreaks of Ebola in Uganda. The hypothetical risk map of proposed risk factors could serve as an initial guide for targeted surveillance and risk investigations for ILRI and its partner organizations in Uganda to elucidate the roles pigs may play in many new diseases, not just Ebola.

Implications

The potential for research like this to elicit a broad alarmist response, stigmatization of an implicated area or involved host species with retribution attacks and culling events is high. It is important to communicate and conduct this research with care as the implications for pig production, wildlife conservation and human health could be devastating and counterproductive to the ultimate aim of improving livelihoods of the poor in Uganda.

Pig depopulation campaigns as a response to their potential implication as a host for Ebola would have large impacts on food safety and security. This was evidenced in the 2009 swine flu outbreaks in places where extreme, unfounded culling programs, in countries like Egypt, took place and led to riots, racial tension and warnings about impacts

on the tourism industry. In this scenario, promises of compensation for farmers were not kept, and they were left without secure livelihoods. Furthermore, poor hygiene at slaughter and the practice of unrestricted selling off and movement of sick pigs in Uganda practised on a mass scale could pose greater risk in terms of exposure to bodily fluids of infected animals and the expedient spread of the disease across the country.

Culling bats or other wildlife potentially implicated, already witnessed in several African countries, would represent similar amplified transmission risk and would have devastating outcomes for conservation efforts and biodiversity in Uganda. Bats play many roles in the ecosystem, including pollination, seed dispersal and insect pest reduction⁷. These roles provide invaluable services to people directly and indirectly, thereby supporting healthy ecosystems and countless livelihoods.

Furthermore, several studies have proven that culling bats is an ineffective or even counterproductive method of controlling zoonotic diseases. Bat colonies subjected to culling or eviction have been shown to exhibit higher rates of infection in re-colonizing populations⁸. If bats should indeed be carriers of diseases, the risk of people getting infected will likely increase rather than decrease due to short-sighted culling or eviction attempts.

Recommendations – A One Health approach

Using a One Health approach to investigate if and how the Ebola virus is or could be infecting any of Uganda's pig populations will help the country expend its limited veterinary and medical health resources more efficiently. Such research could involve veterinary and medical professionals, wildlife biologists and social anthropologists working together to understand the ecology of the virus and the risk scenarios involved with its transmission to humans. This approach is critical for detecting and stopping the spread of future Ebola outbreaks and other emerging zoonotic diseases. Ultimately, it serves to ensure the health and livelihoods of Ugandans through improved food safety and security and protection of the country's biodiversity.

There are several complementary messages about disease risk that will aid the efforts towards improved pig production, human health and wildlife conservation. These include risk of infections at slaughter, benefits of housing pigs and restricting movement. Furthermore, by providing measures with which to improve pig production, an alternative to the practice of wildlife hunting and bushmeat consumption is potentially made more appealing. This could ultimately prove beneficial for conservation.

The key messages and goals of this research are to:

- Search for evidence of Ebola infection in pigs in Uganda.
- Understand the role pigs play, if any, in the transmission dynamics of Ebola infection. This includes understanding the within-pig population dynamics.
- Understand the risk factors, if any, to pig farming specifically in relation to possible wildlife transmission cycles.

- Provide methods to improve pig production through nutrition, husbandry and disease control so as to encourage less bushmeat consumption, wildlife trade, forest product utilization and habitat encroachment.
- Strongly promote the message to leave bats alone; not to disturb, touch or hunt them, and to avoid evicting or exterminating bat colonies in an attempt to prevent Ebola infection.
- Promote the benefits of improved slaughter hygiene and emphasize the importance of movement restrictions and enclosed housing in general disease control.
- Prevent stigmatization of an area and retribution attacks by explaining the rarity of a spillover event and the low probability of it re-occurring in the same place. The lack of convincing evidence for any single-source reservoir species to date and the probable multiple-host scenario in highly unusual circumstances with unlikely convergence of factors means that predicting the next outbreak is difficult.
- Understand the potential impact of Ebola, and other zoonotic diseases, on pig production, human health, livelihoods and food security.

Eliza Smith works for KYEEMA Foundation and Christine Atherstone and Delia Grace work for International Livestock Research Institute (ILRI).

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