



Rethinking biosecurity: human – virus relationships in rural Uganda

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Abstract

One dominant narrative of biosecurity permeates our human world. We see viruses as enemies that need to be contained or eliminated. However, when biosecurity measures fail to be implemented, it invites us to recognize the complexities of our relationship with viruses. Furthermore, it makes us question whether we can understand human-virus relationships in other terms than human control over them. This thesis explores the relationships built among rural communities in Northern Uganda and the African Swine Fever (ASF) virus. ASF is an endemic highly contagious disease that kills pigs. Smallholder farmers in this region face significant challenges in raising pigs due to recurring ASF outbreaks and difficulties in implementing biosecurity measures. Using Social Practice Theory and drawing on Multispecies studies, I analyze semistructured interviews with farmers and animal health practitioners to explore how they interact with the ASF virus. The thesis concludes that farmers have adapted to coexist with the virus by developing a set of skills such as hurriedly selling their pigs when an ASF outbreak occurs. In contrast to the approach of animal health practitioners, who prioritize containing the virus through biosecurity measures, farmers prioritize containing their financial investment rather than attempting to control the ASF virus. How farmers approach ASF management may not only be a conscious choice but also a result of the resources, understandings, and skills that have converged in this context.

Keywords: African Swine Fever, Biosecurity, Multispecies, Social practice.

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Abbreviations

ASF	African Swine Fever
FAO	Food and Agriculture Organization of the United Nations
SLU	Swedish University of Agricultural Sciences
SVA	Swedish Veterinary Agency

1. Introduction

Pig production has become a popular activity in rural areas in Uganda as an option for people to improve their livelihoods (Arvidsson 2023; Chenais et al. 2023). However, smallholders face challenges with pig rearing, such as those imposed by African Swine Fever (ASF), a contagious fatal virus that kills infected pigs (WOAH 2019). Even though the virus has been known for more than 100 years, there is still no effective vaccine, making prevention and biosecurity measures the best tool to deal with the disease (FAO 2023).

Several studies have been conducted to better understand the challenges of implementing biosecurity measures in the local context of pig production, which in Northern Uganda is mainly managed by households and small farms. The results highlight different dimensions that constrain the implementation of biosecurity measures. These include structural dimensions, such as farmers' limited resources (Thompson 2021; FAO 2023); power dimensions, with discrepancies between the government's agricultural agenda and farmers' vision of pig rearing (Arvidsson et al. 2022b); relationship dynamics, such as envy and jealousy among farmers (Arvidsson et al. 2022a), special bonds between pigs and farmer's households (Thompson 2021); as well as lack of knowledge of the disease and its management in the communities (Arvidsson et al. 2023; Chenais et al. 2023). Altogether, the studies portray the complexity that constitutes an environmental issue, such as animal disease management, and the importance of interdisciplinarity in its analysis.

However, all these studies have used humans as their starting point, concentrating their analysis on an anthropocentric level. The emphasis has been on policy-making, community approaches, or individual meaning-making, and the attention has been placed on human agency and/or the power of institutions and how these shape animal disease management. The latter approach could be argued to correspond to a bigger biosecurity narrative, one in which it is believed that humans can prevent and control viruses, i.e. have control over life 10/14/24 9:56:00 PM. Shifting the foci to comprehend animal disease management, more in particular, the implementation of biosecurity measures, including a non-human organism perspective and concentrating on the power of life, can potentially

provide new understandings of the situation. Additionally, moving away from the dualism between agency and structure can also complement previous research on the matter. This change of focus can be achieved through the use of a Multispecies perspective and Social Practice Theory.

Multispecies studies provide a perspective that acknowledges other organisms' role in human social environments and delves into areas where the lines that separate human nature from non-humans are blurred (Kirksey & Helmreich 2010). This can offer alternative standpoints to normalized pathways of understanding human practices. For instance, a generalized conception of biosecurity operates under the premise of managing the possible routes through which viruses can come in contact with healthy life (FAO 2023). There is an assumption that biosecurity can act as a barrier, a defense system to prevent the introduction of viruses. However, a multispecies approach, acknowledges how viruses are entangled with human lives as part of the human social world, and how their separation is an impossible ideal (Blanchette 2015). Hence, biosecurity practices could benefit from shifting their approach from - being prepared to contain a disease outbreak - to - "living with the possibility of" an outbreak (Hinchliffe et al. 2013:536). Although it seems just a matter of words, this change of terms in which biosecurity is framed can influence the practice. Understanding biosecurity in terms of embracing the possibility of an outbreak would shift its focus from implementing procedures to create borderlines and "walls" for containing the disease to investing efforts to strengthen the ability of emergency capacity building (Hinchliffe et al. 2013). The latter example does not intend to point out which approach to biosecurity measures is more beneficial for animal disease management, but to point out how broadening the scope of analysis to non-human perspectives can help question practices that are taken for granted.

Likewise, the use of Social Practice Theory can potentially point out new insights into the practice of ASF management. Under this scope, the practice itself becomes the center of the study, allowing to building of explanations for phenomena that do not rely exclusively on human self-interests or the power of structures (Westberg & Waldenström 2017). Hence, the studies around ASF management in the local context can be complemented by a broader picture of the elements that integrate the practice and how these are connected. Local communities have created a routinized way of dealing with ASF outbreaks, a logic of practice that is a result of the combination of a set of skills, meanings, and materials that have come together in this specific time and space. External norms and individual agency do influence and have an impact and consequences on the way practices are performed, however, they do not steer the practice (Arts et al. 2014). Hence, I consider that, in the quest for a better understanding of the

challenges of implementing biosecurity measures, this breakdown into the core elements that constitute the way the community practices ASF management can be useful.

1.1 Aim and research questions

This study aims to highlight the agency that non-human organisms have in the management of animal diseases and the implementation of biosecurity measures, specifically when it comes to managing ASF in a local community. To do so, I use Social Practice Theory to first define and comprehend the practice of managing ASF, as understood by farmers, veterinarians, and paraprofessionals. Subsequently, I analyze the practice in light of the ASF Virus agency, drawing on a Multispecies perspective, aiming to challenge normalized conceptions of the implementation of biosecurity measures and finding new pathways to comprehend our relationship with viruses. In a world where viruses are commonly seen as enemies but are deeply entangled in our human lives, are there alternatives to relate to them? To achieve this, I address the following research questions:

1. How do farmers, paraprofessionals, and veterinarians, currently practice ASF management?
2. How does the virus itself influence this practice?
3. Does acknowledging the virus agency and its role in human relationships offer an alternative to the way ASF management is practiced?

With this approach, I hope to complement the knowledge that previous studies have set regarding the management of ASF outbreaks in Northern Uganda among smallholders. Furthermore, hopefully, it can incentivize the use of a Multispecies perspective to widen the standpoints used when addressing environmental issues.

2. Background

2.1 African Swine Fever, the virus

African Swine Fever is a viral disease that can lead to the death of domestic and wild pigs. The virus can be hosted and transmitted by wild boars, warthogs, bush pigs, giant forest hogs, and ticks. Direct transmission can occur through contact with hosts, and infected pigs' blood, tissues, secretions, and excretions. Indirect transmission can happen when pigs come into contact with surfaces of vehicles, tools, clothes, and other objects that have been exposed to the virus (WOAH 2019). Hosts such as ticks can carry the virus for a long time, some species can even carry it for about 5 years, and the virus can remain active for different periods in feces, blood, and uncooked pork from contaminated pigs as well as contaminated pig pens, feed and water, among others, making the spread of the virus harder to control (Liu et al. 2021).

The virus is highly resistant to low temperatures and can be inactivated by heat at 56°C for 70 minutes or at 60°C for 20 minutes. Chemicals and disinfectants can also inactivate the virus. For example, if the virus is exposed for 30 minutes to 0.5% chlorine it can be inactivated. The effectiveness of disinfectants can vary according to the product type and its time of storage (WOAH 2019). Although the virus can be inactivated through heat or disinfectants, it must be done under specific conditions, which might not always be applied or even known by smallholder farmers (FAO 2023).

The virus can manifest in domestic pigs in peracute, acute, subacute, and chronic forms. In the peracute scenario, the pigs die suddenly with few signs. In the acute form, where the virus is highly virulent, the mortality rate is usually close to 100%. Pigs die within 6 to 13 days, or up to 20 days, after experiencing fever, reddening of the skin, anorexia, vomiting, diarrhea, and eye discharge. In the subacute form, caused by a moderately virulent virus, pigs experience slight fever, reduced appetite, and depression, and die within 15 to 45 days. This form has a mortality

rate varying widely between 30% to 70%. The chronic form, caused by the less virulent form of the virus, develops over 2 to 15 months and has a lower mortality rate. However, few surviving pigs may become virus carriers for life (WOAH 2019).

2.2 Biosecurity measures against ASF

The following section provides an overview of biosecurity measures suggested by the Food and Agriculture Organization of the United Nations (FAO 2023), focusing primarily on the measures that should be taken by farmers. Nevertheless, it is important to highlight that the effectiveness of biosecurity measures to prevent ASF outbreaks is highly related to their implementation by all the different actors in the value chain of pig production (farmers, traders, slaughterhouses, pork joints, consumers, animals among others) as well as visitors to the households where pigs are being kept. Studies have shown that local communities that work together tend to be more successful in the implementation of the measures (Chenais et al. 2023; FAO 2023). However, due to the limited scope of this master thesis, biosecurity recommendations involving other actors are not included.

The suggested measures by FAO have as a starting point the “concept of a farm as a fortress [...] keeping those inside safe and keeping the “enemy” at bay outside” (FAO 2023:11). Hence, one of the main recommendations is to build a structure for keeping pigs confined instead of letting them roam free, to avoid healthy pigs getting in contact with the ASF virus. Preventing healthy pigs from getting in contact with sick ones includes developing a system for breeding. As the virus can also be carried by people and contaminated clothes or objects, people entering the farm must have a proper disinfection process, which includes making sure they wash their hands and use dedicated footwear. Another important measure is not feeding pigs with unboiled food waste or leftovers as they might contain contaminated meat from sick pigs (FAO 2023).

It is important to note that smallholder farmers may possess knowledge of biosecurity measures, but this knowledge does not always translate into implementation. Building structures to keep pigs confined might be out of farmers’ budget (Thompson 2021; FAO 2023). It also creates an additional demand for farmers who need to feed the confined pigs and provide them with water that they would roam for themselves if kept free. Similarly, measures that involve constant

investment, such as purchasing disinfectants, are not usually adopted consistently by farmers with limited resources. Furthermore, disinfectants might be used improperly when farmers do not provide sufficient time for the ASF virus to become inactive or the use of wrong dilution rates (FAO 2023).

In the case of an ASF outbreak, additional biosecurity measures need to be implemented. These include, for instance, the correct disposal of sick and dead pigs, which should be buried or burned. Prompt reporting of the outbreaks is also highly recommended to prevent the spread of the virus by reinforcing the implementation of the previously mentioned biosecurity measures, e.g. suspending breeding with the use of shared boars or restricting the access of visitors to pig-keeping households. Additionally, movement restrictions might be implemented at a local or national level (FAO 2023).

2.3 Pigs, farmers, and veterinarians in Northern Uganda

Between 2022 and 2023, Uganda's livestock sector contributed four percent to the GDP (UBOS 2024). In 2021, approximately 72 percent of households were involved in raising at least one type of livestock, from which 33% kept pigs. The Ugandan government and donors have actively promoted pig production as a key strategy to enhance the livelihoods of rural communities (Arvidsson et al. 2022b; a). In 2021, the pig population reached 7.1 million, a 122.5 percent increase from the 3.2 million pigs reported in 2008 (UBOS 2024). This increase has also been observed in Northern Uganda, a region that had been deeply affected by armed conflict, leading to the displacement of communities and deprivation of resources (Arvidsson 2023).

Focusing on the monetary dimension of poverty, pigs are considered a way to mitigate poverty as they grow and reproduce fast, deliver multiple piglets, do not require much land, and can be easily sold (Arvidsson et al. 2022b; Arvidsson 2023). Furthermore, the Ugandan government sees pig production as an opportunity for smallholder farmers to go from subsistence farming to commercial agriculture and improve their economy. This dominant discourse is carried by veterinary education, government officials, and some field veterinarians, who believe farmers need to have a mindset oriented to building bigger operations and integrating their farming into the formal market (Arvidsson et al. 2022b). However, in 2021, despite the

overall growth of the pig sector, the typical pig-keeping household kept an average of 3 pigs, the same average reported in 2008 (UBOS 2024). Previous research amongst smallholder pig farmers in Northern Uganda also suggests that smallholder farmers' goals more commonly are to earn money that allows investing in a better quality of life, sometimes involving less engagement in farming, rather than engaging in scaling up farming for commercial purposes (Arvidsson et al. 2022b).

Most smallholder farmers in the studied villages let their pigs roam free or only partially keep them tethered, and they rarely have pig pens or structures for their confinement. This represents a challenge for containing ASF outbreaks as the pigs can come in contact with hosts that carry the virus, contaminated objects or areas, and sick pigs. I identify two key reasons why smallholder farmers in Northern Uganda rarely invest in biosecurity measures, seeing the pigs as quick money and the lack of access to appropriate information on ASF.

Similarly to the development organizations and government efforts that have worked to stimulate pig production as a way to reduce poverty by gaining money, farmers also see pigs as a comparatively easy strategy for gaining quick money, as they represent a low threshold investment that can provide fast income that can be used to pay for school fees or emergency expenses (Thompson 2021). Due to this understanding of pigs in terms of low investment and big profit, and an awareness that pigs can become sick and suddenly die, some smallholder farmers often decide not to invest in biosecurity measures (Thompson 2021).

Another challenge for the adoption of biosecurity measures relates to the lack of local knowledge on pig production and the lack of access to appropriate information on pig management and ASF. In the studied communities in Northern Uganda, pig rearing is a more recent practice compared to keeping other animals such as cattle, goats, and poultry (Arvidsson 2023). Therefore, farmers express that they lack knowledge of how to deal with pig diseases, including ASF. The fact that farmers in this area also struggle to access veterinary services further undermines access to information on how to deal with ASF.

The adoption of new programs, conditional international loans, and structural changes in the 1980s and 1990s turned into the privatization and downscaling of veterinary services in Uganda. As a result, in addition to government veterinarians, private practitioners were introduced into the veterinary system, and the veterinary drug market was liberalized (Arvidsson et al. 2022b). Private practitioners comprise paraprofessionals, who are animal health practitioners who lack a university degree but have diverse and (in the case of contemporary Uganda) unregulated training. It has been argued that paraprofessionals should work collaboratively and refer to

veterinarians to ensure the correct practice of their services (Ilukor et al. 2014). However, in the local context, paraprofessionals rarely work under this supervision. Paraprofessionals tend to be the main providers of veterinary services in villages, as professional veterinarians tend to localize most of their work in cities or bigger towns, making smallholder farmers more susceptible to receiving incorrect advice or improper treatment for their animals from paraprofessionals. In the context of ASF, a study revealed that paraprofessionals often administered injections to pigs as a preventative measure for the disease, despite being aware that there is no vaccine available for treating ASF (Arvidsson et al. 2022b).

3. Theoretical framework

In the present thesis, I use Social Practice Theory and a Multispecies perspective as a theoretical framework. Social Practice Theory, provides the tools to define ASF management as a practice, mapping out the *materials*, *meanings*, and *competences* farmers, veterinarians, and paraprofessionals engage when dealing with ASF cases. Furthermore, it is used to highlight and analyze the role of the virus, its agency, and how it shapes the practice and the social relations between the previously mentioned actors. The Multispecies approach intends to unveil the possibility of considering other alternatives in which viruses and humans can relate, challenging normalized narratives in which viruses are understood only in terms of “enemies” to be contained. Below, I present an overview of both theories, and how this theoretical combination can encourage reflection on how veterinarians, paraprofessionals, and farmers currently manage ASF, and if there are alternative ways to understand their relationship with the ASF virus.

3.1 Social Practice Theory

Social Practice Theory focuses on understanding social practices, which are the habitual patterns that emerge around the way people perform an action (Webb & Tarleton 2018). A social practice can be an ordinary everyday action such as driving a car or brushing one’s teeth, as well as broader actions such as nature tourism or forest governance. In this theoretical approach, the focus is not on the agency of the individuals who perform the practice or the structures involved, but rather on the practice itself and the elements that constitute it (Webb & Tarleton 2018). As an example, in a study conducted by Omer and Roberts (2022) to identify opportunities to promote sustainable workplace consumption in a hospital, Social Practice Theory was used to understand which practices were generating the most energy consumption and how these were configured. Differing from a traditional method of finding strategies to promote environmentally friendly behavioral change through emotional and cognitive incentives, or structural modifications, the

study concentrated on which elements were involved in the practice and how the practice could be reconfigured (Omer & Roberts 2022).

The elements of a social practice can be sorted into three categories: *materials*, *meanings*, and *competences* (Shove et al. 2012). The *materials* are the “objects, infrastructures, tools, hardware and the body itself” (Shove et al. 2012:2) present in the practice. In Omer and Roberts’ study (2022) the *materials* involved when analyzing the use of energy in hospital practices included elements such as the physical infrastructure of the hospital (rooms, wards, storage spaces), medical and office equipment, lights, and light sensors. The *competences* are understood as the know-how and skills involved in the practice (Shove et al. 2012) that becomes normalized as a routine, a logic of the practice (Arts et al. 2014). Referring again to the example provided by Omer and Roberts (2022), some of the *competences* of the hospital staff included conducting morning rounds, working on shifts, and leaving certain doors open for convenience. The third element of a practice is the *meanings*, which refer to the social and symbolic connotations given to the practices, they are part of the practice, rather than external forces or personal motivations that influence it (Shove et al. 2012). Following the previous example, one of the *meanings* the researchers identified was that some of the actions the hospital staff performed were driven by a patient-benefit perspective, constantly trying to provide the patients with comfort (Omer & Roberts 2022).

The links created between the *materials*, *meanings*, and *competences*, determine and shape the practice (Shove et al. 2012). In Omer and Roberts’s (2022) study, the researchers identified how the *meaning* of the staff being patient-benefit oriented, shaped how they used the *materials*, positively impacting the energy consumption. The staff often turned off the halogen ceiling lights to reduce the heat in the rooms to make patients more comfortable. It was a sustainable practice that wasn’t guided by environmental motives or personal interests but by the configuration and the links of the elements of the practice. Likewise, the study portrayed how energy waste depended on the links between *competences* and *materials*. For instance, leaving some doors open for the practicality of daily activities, made the light sensors of other rooms activate even when the rooms were not in use. The latter portrayed how energy waste was an effect of the logic of the practice, of the routinized way in which the staff carried out their daily activities. That logic is built through the connection of the different elements.

When addressing stability and change in a practice it is important to consider that different practices are connected, therefore change in one practice impacts the other (Webb & Tarleton 2018). For example, a daily practice such as riding your bike to work is influenced by other practices such as urban planning. Cities with

dedicated lanes, parking spots, and air pumps, influence how people ride their bikes. For example, if a town that usually has several air pump stations scattered around suddenly decides to remove them, people will adapt by using portable air pumps or learning where bike workshops are located. This will also lead to increased awareness of the air levels in their bikes. It is important to note that practices can be influenced by external factors, however, the impact of external changes depends on how the participants perceive and react to these changes (Westberg & Waldenström 2017). Following the latter example, whether people would buy portable air pumps, schedule visits to bike workshops, or come together to create a communal air pump in their residential building, is something that can only be incorporated into the practice by the practitioners. Likewise, the adoption of these new *competences* or *materials* into the practice would be determined by the feasibility in connection to the other elements of the practice.

For this study, Social Practice Theory was chosen to gain an understanding of how the local community is currently managing ASF. By breaking down the practice into smaller units, i.e. the elements of the practice, I intended to deeply comprehend how it is being operated in the particular context of a rural community and the role the ASF virus plays. However, the use of Social Practice Theory posed some limitations regarding my thesis aim which sought to explore the possibility of finding alternative paths to understanding the relationships built between humans and viruses. Therefore, I chose to complement the analytical framework with a Multispecies perspective.

3.2 Multispecies studies

Multispecies studies challenge anthropocentric perspectives in which the main focus is the human perspective (Kirksey & Helmreich 2010). Multispecies studies emphasize how the lines between humans and non-humans are blurred and permeable, as our human nature involves relationships and dependencies with other species (Kirksey & Helmreich 2010; Galvin 2018). Of specific relevance for this thesis, multispecies studies invite to acknowledge the continuous interaction and exchange between humans and pathogens, which can result in the creation of new realities (Hinchliffe 2015). For example, zoonotic diseases, which involve the transmission of animal diseases to humans, are not seen as random occurrences due to contact or contamination. Instead, “they involve repeated crossings, an ongoing conversation” (Hinchliffe 2015:31) between humans and non-humans so that pathogens can develop the ability to affect humans. When considering human and

virus relationships from this perspective, it is possible to observe how these ongoing conversations can create the exchange of gifts between species. In the case of human viruses, the exchange between humans and non-humans contributes to the development of the human body's immune system. This perspective opens the door to imagining other ways humans and viruses relate, moving away from a view in which viruses only represent a threat (Greenhough 2012). The use of a Multispecies perspective changes the normalized mindset in which humans try to control and enforce power over non-human worlds, to consider that humans can act responsibly and learn to live together with other species (Greenhough 2012).

Greenhough (2012) exemplifies this through a study in which she analyses the relationship developed between the common cold virus and humans in a facility designed for its studies in the 1940s. A group of volunteers were placed in a confined facility to enable researchers to explore how the common cold virus was spread and the factors influencing humans' vulnerability to colds. In this scenario, the perspective of the virus as an enemy that had to be separated from healthy life was replaced by an interest in fomenting the virus's reproduction and interaction with human bodies. In this context, the responses of the human body's immune system to the virus were understood as a way of embodied communication between the virus and the researchers. The appearance of cold symptoms in the volunteers communicated and provided insights to the researchers about the virus agency. Through its physical manifestation on the volunteer's bodies, researchers were able to learn if the cold virus was in fact a virus instead of a bacteria. Likewise, the cold virus was also suggested to express itself through human language. A set of guidelines with specific terms such as doubtful, mild, and severe, were given to the volunteers so that they could describe their relationship with the virus, making the volunteers translators between the virus and the researchers (Greenhough 2012). Instead of viewing human language as a mere reflection of human agency, a multispecies perspective emphasizes the role non-humans play in the human world.

Applying a multispecies perspective can also point out incongruences in the concept of biosecurity. The normalized conception of biosecurity operates under the foundation of keeping healthy life separated from pathogens. As illustrated by FAO (2023) through the metaphor of the farm as a fortress, biosecurity should keep the ASF virus enemy away. To do this, sanitation processes and surveillance procedures are given priority to ensure that rigid borderlines are not crossed, and if they are crossed, humans should be able to react promptly to contain the disease (Hinchliffe et al. 2013). However, human and non-human relationships are more complex, making bio-insecure areas uncountable as they emerge in everyday human social interactions (Blanchette 2015). Diseases in most cases do not arise on the other side of the borderline but are created within the so-called "enclosed"

spaces where healthy life operates. Therefore the concept of borderlines should be replaced by borderlands, as the latter recognizes the contact points between the two sides and the dynamic permeable relationship among them (Hinchliffe et al. 2013). Moreover, it can be argued that the interconnected relationships between humans and pathogens actually facilitate the co-evolution of life, and isolating from pathogens can also negatively impact human health. In certain cases, rigorous hygiene protocols designed to keep viruses away can weaken human health. As an example, strict modern indoor cleaning practices, not only expose humans to chemicals but also reduce microbial diversity, which can impose risks for human well-being (Wakefield-Rann et al. 2020). Human–virus interaction can generate positive outcomes. As exemplified in Greenhough’s (2012) study, the contact of humans with the common cold virus allows the human body to develop and strengthen its immune system. From a multispecies perspective, being healthy is not about being completely separated from pathogens, but rather about having the ability to coexist with a variety of organisms that are always present in the environment (Hinchliffe et al. 2013).

Multispecies studies can also allow us to comprehend the role non-human species have in the social world. Analyzing Blanchette’s (2015) research on the Porcine Epidemic Diarrhea virus in the United States from a multispecies perspective can illustrate this. His study points out how the factory farm is reversing the hierarchy between humans and pigs, constraining human actions for the benefit of pig production. Blanchette (2015) highlights how biosecurity protocols in pig factories influence human lives beyond the workplace limits. For instance, he recalls how a newlywed had to quit her job taking care of piglets because her husband worked in the slaughterhouse of the same company, or how a senior manager barely recognized the workers under his supervision because he shouldn’t socially interact with them. Strict biosecurity protocols were implemented to prevent overlaps between workers’ private living arrangements and social interactions due to the fear of employees carrying and spreading the virus, despite following showering protocols. Blanchette (2015) aims to emphasize the emergence of a postanthropocentric biosecurity protocol, where the goal is to protect the industrial pig from humans, as they may put pigs at risk. According to this premise, human social interaction becomes the main host for porcine disease to thrive. Although his study might not be framed within a multispecies perspective, when analyzed from this perspective, it portrays how social dynamics and public spaces can be redefined by the agency of a virus. Human social interactions are impacted by the biosecurity narrative and the nature of the virus, i.e. highly contagious, ability to remain active and be carried by humans.

4. Methodology

4.1 Data collection

The present thesis is based on data collected through interviews conducted at the end of January and beginning of February 2024 in a local community in Northern Uganda. Thanks to the endorsement received by an ongoing research project on the impacts of ASF in smallholder pig systems in Uganda held by the Swedish University of Agricultural Sciences (SLU) and the Swedish Veterinary Agency (SVA), I was able to travel and stay with a local family for three weeks to conduct the interviews. I had complete autonomy to define the focus and research question of my study (within the context of ASF) and the methodologies for data collection, however, the place and the work team were already defined. The latter had some implications further discussed in section 4.3. *Reflexivity* of this chapter.

In total, 46 individual and three group interviews were carried out. From those, 17 of the individual and two of the group interviews were conducted together with a postdoctoral researcher and a local interpreter. I did 12 individual interviews and one of the group interviews without the postdoctoral researcher. The remaining 17 interviews were conducted by the postdoctoral researcher without me. I was granted to use the interviews made by the postdoctoral researcher in cases where these were of value for giving richness to the specific research questions in focus for this thesis. All interviews followed a semi-structured approach, using a set of initial questions complemented with new questions that emerged according to the conversation with the interviewees, to deepen on information of interest.

The interviewees were 47 farmers who at the time of the interview, or in the past, owned pigs, five veterinarians, and five paraprofessionals. They were all informed of the objective of the interview and asked for oral consent before recording. They will be referred according to their role (farmer, veterinarian, or paraprofessional) and the order in which they were interviewed, i.e. Farmer 1, Farmer 2, Paraprofessional 1, Paraprofessional 2, Veterinarian 1, Veterinarian 2, etc.

The distinction between veterinarians and paraprofessionals is based on my interpretation of the background education the interviewees mentioned during the interviews. Animal health practitioners who self-identify and or are identified by others as veterinarians and have completed a diploma and or a certificate, but do not have a formal degree, are referred to as paraprofessionals. Those with university degrees, whether in veterinary medicine, animal production, or agriculture, are referred to as veterinarians as they practice as extension officers and veterinarians/veterinary assistants.

The interviewees were selected based on that they had experience with pig rearing. They were recruited based on information provided by sub-village leaders, the interpreter, and a local researcher involved in the SVA and SLU research project, who was a former District Veterinarian Officer and will be referred to as Local Researcher. For further detail on the selection method see *Table 1. Selection of interviewees.*

Table 1. Selection of interviewees

Participants	Number of participants	Interviewing method	Selection method
Farmers who own pigs	32	Individual interviews	Selected from a list provided by the sub-village leaders when asked about people who own pigs.
Farmers who owned pigs in the past but currently are not rearing pigs	7	Group Interview 1 + individual interviews	Selected by the interpreter based on his local knowledge and network, upon the request of finding farmers who owned pigs in the past but quit rearing pigs. When conducting the interviews, it turned out the interviewees had not quit completely, but stopped momentarily and were eager to resume again.
Farmers who were experiencing a possible ASF outbreak	8	Group Interviews 2 & 3	Selected by Local Researcher when notified by a local health animal practitioner that pigs were dying in surrounding villages. These interviews were conducted

			in the company of the Local Researcher, as it also served him as an opportunity to collect blood samples from possibly infected pigs.
Paraprofessionals	5	Individual interviews	Three of them were mentioned by farmers during their interviews, one is a colleague of one of the referred paraprofessionals, and one was suggested by Local Researcher.
Veterinarians	5	Individual interviews	Selected by Local Researcher, upon the request of providing contact details of veterinarians.

The sampled farmers did not represent a homogenous group, some have active roles in the community (witch doctor, treasurer of the village savings and loans association, village leader, among others), others identify only as farmers, some recently moved to the village, others were born and raised there, among other particularities. Both men and women were included from a different range of ages, 17 being the youngest and 76 the oldest. At the time of the interviews, most farmers had between one and four pigs, including piglets. Only eight farmers had ten or more pigs, with 29 being the highest number. The interviewees share to some extent a similar economic situation. Most of them own the compound where they live, as well as some land for gardening. Likewise, the majority do not own cattle, which is a more expensive investment, but pigs and other types of animals such as goats and/or poultry, and most of the farmers have been able to send their children to school at some point.

A total of 39 farmers live in the same village where I was staying, and eight live in two other villages where a possible ASF outbreak was developing. We conducted two group interviews with the farmers of these two villages as an opportunity to obtain fresher perspectives about farmers' thoughts on pig disease management, as most of the farmers of the main village of study had not experienced an outbreak of ASF since 2023 or earlier. Of the five veterinarians and five paraprofessionals interviewed, four paraprofessionals live in the main village of study, and most of the rest live in the closest town to the village.

The interviews with farmers were conducted in the local language Luo, and the interviews with the paraprofessionals and veterinarians were conducted in English. The interpreter was present in most of the English interviews, in case the interviewees had trouble conveying their ideas and momentarily had to express themselves in Luo. Furthermore, the interpreter's local knowledge and understanding of SLU and SVA's research project and ASF, made him a key colleague for conducting the interviews and for giving input to the discussions we often had at the end of the day to reflect or clear out doubts.

Most interviews were voice recorded but were not fully transcribed. I took detailed notes of all the interviews in a notebook, and when in doubt about my interpretations, I cleared out questions with the interpreter and the postdoctoral researcher. I typed up all my notes on the computer. While doing so, I listened to the recordings to ensure their accuracy, added detail, and made sure that I had not missed anything, but I did not transcribe the recordings verbatim. For the interviews that were conducted together with the postdoctoral researcher or by the postdoctoral researcher without me, I used her typed-up notes and cross-checked them with my notes. It is important to note that the quotes used in this thesis are based on the previously mentioned notes and are not verbatim.

4.2 Data analysis

I color-coded the interviews using a Social Practice Theory framework to understand how the local community practices ASF management. I use the term ASF management to refer to the actions performed by farmers, veterinarians, and paraprofessionals to handle the ASF virus. This encompasses actions conducted by farmers such as calling for a veterinarian when the pig is sick and or selling sick pigs or healthy ones out of fear of them getting infected, as well as actions taken by veterinarians and paraprofessionals like taking pigs' blood samples, reporting or training, among others. Hence, this thesis provides an overview of the practice of ASF management based on insights from studying only some of the stakeholders involved in the value chain of pig production. Other important actors, such as pig buyers, slaughterers, and consumers, are not considered in this study although they all play a role in shaping the way the practice is conducted. One of my thesis objectives is to highlight the role of non-human organisms in the management of animal diseases, rather than producing a detailed examination of how the stakeholders of the complete value chain carry out the practice.

It is important to note that the interviewed farmers were not specifically asked about ASF management or whether their pigs had contracted this disease. Instead, they were asked about any problems or challenges they had experienced while raising pigs. Some farmers who mentioned pigs' sickness as a challenge were aware of ASF, while others were unsure about what disease had affected their pigs. Farmers who did not mention ASF specifically, but discussed pigs dying from sickness shared similar descriptions about the disease that affected their pigs, which could indicate that it was a case of ASF. Three significant factors that were consistently mentioned included the rapid progression of the sickness, with pigs dying shortly after showing signs of weakness or other symptoms, that the sickness came during the dry season and the observation that multiple pigs were dying simultaneously. Even if the farmer being interviewed only owned one pig that died, they mentioned how other farmers in the community were experiencing similar issues with their pigs at the same time. The following quotes illustrate the type of comments made by the interviewees. Farmer 24 recalled that when 24 of her pigs died “All the farmers in this area experienced the same thing. They [the pigs] all died. You would go to the neighbor and find they had the same problem”. Farmer 29 when asked how she knew it was ASF and not something else that killed her pigs mentioned, “We have other diseases, but they do not kill pigs in the whole area”. When farmers shared experiences about what seemed to be other types of sickness, such as a pregnant sow constantly urinating or pigs with ticks, I took the statements as a reference for understanding the bigger picture of how farmers manage pigs as a whole practice and how that practice also influences the practice of ASF management, this is further discussed in part of chapter 5. *Findings*.

As Shove et al. (2012) explain, a practice is made of the relations and dependencies among *meanings*, *competences*, and *materials*, therefore, detecting these elements allows one to set the boundaries and define a practice. Furthermore, identifying and comprehending that a practice is the routinized and normalized way people perform an activity, can shed light on expectations on which the practice builds and how the practice shapes the environment it is embedded in (Wakefield-Rann et al. 2020). Hence, I started my data analysis by using a qualitative data analysis software to identify the *competences*, *meanings*, and *materials* farmers, veterinarians and paraprofessionals associate with ASF disease management. The following quote from Farmer 24, when asked if there is anything she does to prevent her pigs from getting sick, exemplifies how the interviewees' statements were used to distinguish these three elements:

“Yes, I am not going to buy pork from anywhere around here. And when the heat is coming, I have made this pit for Maria [their pig] to pour water in and keep her cool. I also want Maria to get injections. I have a plan for that because they say you don't need to wait until the pig is

sick to get injections. [...] I got this advice from someone who has knowledge about pigs. They say that it is better to give the injection before Maria gets sick”.

To begin with, the farmer's affirmative answer and the examples of measures she will take to prevent her pig from getting sick portray how ASF management is associated with the *meaning* that viruses/diseases can be controlled to some extent. This builds on the belief that humans have power over the virus and can manipulate it to prevent it from infecting the animal. Furthermore, to practice this power you need to know how to control the virus or have the ability to get in contact with someone who does. In this case, the person Farmer 24 refers to, is her neighbor who works as a veterinarian for a large farm in the village. Knowing about the virus or finding a contact person who knows, becomes the *competence*. The person with the knowledge, in this case, the neighbor who is a veterinarian, is part of the *materials* of the practice, along with the pit with water and the injections.

The latter example, also portrays how the elements are connected within each other, constituting the practice. The *competence* (having knowledge about how to manage pigs' diseases) determines the need for certain *materials* (like the veterinarian). This also reinforces the *meaning* creating expectations that the virus can be controlled.

Once I coded all of the interviews to identify the elements of the practice, I clustered the information on a set of findings which afterward, I analyzed taking into account a multispecies perspective. For this, I interpreted the findings in the light of multispecies literature seeking to understand the relationship developed between farmers, veterinarians, paraprofessionals, and the ASF virus, in other terms rather than the control of humans over non-humans.

4.3 Reflexivity

Before presenting the results of this study, it is important to consider my role as a researcher, my biases, and my background, as they influence the interpretation of the collected data and the way the study was conducted (Creswell & Creswell 2018). Being a student and not possessing an academic or professional background in veterinary science, might have influenced the way the interviewees interacted with me. This became clear to me while we conducted the first group interview accompanied by Local Researcher. During that interview, the farmers' answers might have been constrained due to being in front of someone “with proper knowledge” rather than being just with a student who was not even from the veterinary field. When addressing questions such as what they thought caused the

disease that killed their pigs or if they would do anything different in the future to prevent the pigs from getting sick, the interviewees responded by asking us back the same questions with phrases such as “Right now I don’t know but I am hoping you will give us some knowledge” and “Because you are the experts here, I think that you should tell us”. These types of answers were less frequent when I conducted the interviews on my own. Likewise, when the veterinarians, paraprofessionals, and farmers mentioned concepts that I was unaware of, they would explain them to me. As a result, much of my understanding came from the local context rather than from any preconceived notions I may have had if I had extensive knowledge of ASF management. This lack of knowledge and experience affected me in two ways. On one hand, my lack of knowledge led to open responses from the interviewees. On the other hand, it's possible that I missed important remarks from the interviewees that could have prompted me to ask different follow-up questions about animal disease management.

One other aspect that influenced this thesis was the opportunity to collaborate with a postdoctoral researcher and an interpreter. By my arrival at the place of study, they had already initiated the fieldwork by identifying the distribution of sub-villages, establishing a sampling frame, and creating a list of potential interviewees, among other tasks. Additionally, the postdoctoral researcher had previously reviewed the questions for the farmers’ interviews with the SLU and SVA research teams. Most probably if I had conducted the study by myself the questions might have been somehow different. However, the defined set of questions aligned with my general research interest and I had the opportunity to ask additional questions to the interviewees. Conducting the data collection with a team with a lot of expertise enabled me to conduct numerous interviews that I would not have been able to do alone. Furthermore, being together with the postdoctoral researcher boosted my confidence as I was able to see her in practice and learn from her approach to handling the interviews. In addition, I had the opportunity to seek feedback and share thoughts and questions with the postdoctoral researcher and the interpreter, for which I am very grateful.

The use of an interpreter had a significant impact on this study. Since I didn't speak the local language, I had to rely entirely on the interpreter for both translating the language and interpreting the meaning of what the interviewees said. This had both advantages and disadvantages. On one hand, the interpreter may have missed small details that could have been important for me to follow up on. On the other hand, as a local interpreter, he had a deep understanding of the local culture, which helped provide a more accurate interpretation of what the interviewees meant by their words.

5. Results

This section presents the primary findings on how participants manage ASF. To do so, I begin by discussing the different *meanings* animal health practitioners (veterinarians and paraprofessionals) and farmers have attached to the practice. This sets the ground to point out the main *competences* and *materials* of the practice. Afterward, I present the assumptions and expectations built around the practice and how the different elements of the practice are connected. I finish by discussing the virus agency.

It is important to clarify that farmers in this study rarely differentiate between a veterinarian and a paraprofessional and use the term vet to refer to either of them. Therefore, when I refer to farmers' comments about veterinarians or paraprofessionals, I will also use the term vets, to stay true to farmers' own experiences. In contrast, when I speak of veterinarians or paraprofessionals, I differentiate between them when the data allows it.

5.1 ASF Management: Containing the virus or containing the money?

Practitioners of a certain activity can attribute different *meanings* to it (Webb & Tarleton 2018). In this case, ASF management holds different *meanings* and the use of diverse *competences* and *materials* for veterinarians, paraprofessionals, and farmers. It seems as if ASF management signifies to veterinarians and paraprofessionals an effort to contain the ASF virus and avoid its spread. On the other hand, farmers approach ASF management as a way to contain the money they have invested in pigs and minimize financial losses. In this section, I provide deeper details on these findings.

Based on the interviews, veterinarians and paraprofessionals currently discuss ASF management in terms of trying to control the ASF virus, implying that the

virus can be tamed. Even though they are aware of the lack of a vaccine to treat the virus and its quick spread and high level of contagion, they believe that the virus can be avoided or contained. The following quote from Veterinarian 2 when asked about what she does when encountering a farmer who has a pig with ASF illustrates this: “Then you go and tell them that ASF is a virus and that it cannot be treated, they have to do biosecurity. Biosecurity will not help the sick pig, but it is how we control ASF. You need to be careful when the pig is healthy so it does not get sick because once the pig gets the disease it is too late”. Due to the lack of a vaccine, the only way left to attempt to control the virus is through biosecurity measures, hence this has become the main *competence* of the practice. The *competence* of applying biosecurity measures clusters several of the other *competences* mentioned by the veterinarians and paraprofessionals, such as reporting, teaching farmers about biosecurity measures, and surveilling and controlling farmers’ actions. Below I expand on each of these three examples.

Reporting implies farmers notifying the vets that their pigs are sick and the vets reporting to the District Veterinary Officer (DVO). The DVO sends someone to collect blood samples which are then taken to a lab to verify the presence of the ASF virus. As Local Researcher explained, if one ASF case is confirmed, a quarantine can be imposed to restrict animal movement, slaughter, and sale of pigs on the subcounty level. If $\frac{3}{4}$ of the sub-county is affected by an outbreak, the quarantine is imposed on the whole district. Veterinarian 3 describes the process as follows “The farmer reports the case to me and I go and observe. If, based on the clinical signs, I observe that the signs correspond to AFS I present the report to the District Veterinary Officer [...] The District Veterinary Officer reports to the Ministry, to the Commission of Animal Health”. Some of the *materials* related to this process include owning a motorcycle to reach the farms, the proper equipment to take the blood samples, having a channel to report to the DVO, and paying a small fee for the tests to be analyzed (which is charged to the farmer). If a quarantine is imposed, there is a need for additional *materials* such as those needed for dissemination of the information through meetings with farmers and extension officers, radio announcements, letters delivered to slaughterhouses and pork joints, and checkpoints on the roads, among others.

Reporting can also involve informing the local leaders while waiting for the Ministry to take action, as explained by Veterinarian 2: “The local leaders just advise what to do [...] The real quarantine is run by the Ministry, but what I am talking about here is a community approach, to sensitize the local farmers”. Local leaders might take some actions warning farmers about a possible outbreak so that they can take preventive measures and try to restrict the movement of sick animals.

When discussing the *competence* of reporting, veterinarians and paraprofessionals also mention how they experience challenges because farmers do not report. They differ in their ideas about what might be the cause of this failure in reporting. As an example, Veterinarian 1 believes it is because of economic factors, “There is a big percentage of farmers who do not have the money and then the case is not reported, there is nothing we can do”, while Veterinarian 3 attributes it to farmers lack of interest “Sometimes it is just negligence, they see the sick animal and do not report it, but prefer to let it die. [...] And then you find out that the infection is being spread”. Either way, veterinarians and paraprofessionals see farmers’ behavior as an impediment to containing and controlling the ASF virus.

Another *competence* associated with the practice is teaching farmers about biosecurity measures. Veterinarians and paraprofessionals constantly highlight how once they identify a case of ASF they advise the farmer to implement biosecurity measures. As Veterinarian 3 mentions “While on the farm I also advise the farmers, I tell them they need to isolate the sick pigs, use disinfectant, and handle the pigs like this, as I wait for information from the Ministry”. Some of the other biosecurity measures mentioned by veterinarians and paraprofessionals include keeping pigs confined so that they do not come in contact with the virus, feeding the pigs so that they do not roam free, informing other clients (farmers) about the possibility of an ongoing virus outbreak so that they start applying biosecurity measures, disinfecting the pig pen as well as the farmers’ shoes before going in the pen, restricting peoples movement in and out of the farm, and burning or burying the carcasses of pigs that died from the disease. Some of the *materials* linked to this competence involve the materials for building the structure to contain pigs, feed, and chlorine to disinfect.

When discussing the *competence* of teaching farmers about biosecurity measures, veterinarians and paraprofessionals mention challenges with farmers’ reluctance to keep pigs confined and burning or burying the pigs’ carcasses. As Veterinarian 3 explains “Here, it is common or tradition for people to let their animals move freely to find their food. Confinement in rural communities is not based on disease prevention and control but based on the rain and dry calendars”. As the veterinarian explains, this biosecurity measure does not align with the way farmers raise pigs. As most farmers suggested during the interviews, they keep their pigs roaming free unless it is the rainy season because they believe that this helps the pigs grow bigger and it is also cheaper as pigs can search for their own food. Likewise, the measure of burning or burying the pigs’ dead bodies, does not align with measures taken by farmers in this situation. Farmers will try to slaughter the dead animal and sell the meat. Paraprofessional 1 illustrates the challenge they face: “I will always wait and tell them to burn or bury the pig while I am there present,

otherwise they won't do it". This situation consequently generates another *competence* for ASF management: supervising and controlling the farmers' actions.

As previously described, veterinarians and paraprofessionals constantly comment on how farmers often ignore biosecurity advice by allowing their pigs to roam freely and by selling sick pigs or the meat of dead pigs to buyers in local trading centers, pork joints, or outside the village instead of burning or burying the dead bodies. Paraprofessional 5 explains this "[...] we can put a bylaw to restrict the animals' movement. But it is not easy, the farmers refuse to get losses, so they can try to sneak the animal to sell it. We try our best but it is not easy". There is a belief among veterinarians and paraprofessionals that the ASF virus can be controlled and contained by controlling farmers' actions. However, this task is not easy as farmers have their own doing, and this, I argue, is connected with the main *meanings* I find farmers have of the ASF management practice, which I discuss below.

For farmers, ASF management *means* to control the profit, it is mainly about trying not to lose money. Contrary to what it represents to veterinarians and paraprofessionals, farmers' main objective is not to try to control or contain the virus, but to retain their money, i.e. the money they have invested in the pig, and the profit they expect to obtain. As Farmer 24 explains "When the pigs got sick I called someone that has more knowledge than me about raising pigs. And he came and he advised me that now there's no solution. It might be possible to sell to one of the pork joints. I sold three and two died [...] So, I did get some money but it was not up to my expectations [...] Basically, I broke even, or maybe lost a little bit". The latter quote exemplifies the main *meaning* farmers associate with ASF management, as a skill of finding ways not to lose profit. This can be achieved in two ways, which become the two main *competences* of the practice: contacting a veterinarian or someone considered an expert on pig farming to try and see if the pig, i.e. the investment, can be saved, or selling the sick pig, alive or slaughtered, to get back some money. Ahead I elaborate on these two *competences*.

Farmers constantly expressed how the main thing to do when seeing a sick pig is to contact the vet. This does not necessarily imply that they contact the vet right upon the first signs of their pigs being ill, some of them expressed that they might wait a while and see if the pig gets better by itself. However, the skill of finding or knowing a vet signifies to the farmers more chances of success in keeping pigs, i.e. keeping their profit. As exemplified by Farmer 27, who mentioned how after losing two adult pigs and 22 piglets to sickness, she was willing to have pigs again after knowing a vet was living in the same village: "I saw the vet, and that's why I made the decision to buy a pig". Similarly, being unable to contact a vet or someone with

wide experience in keeping pigs, makes the farmers feel a sense of hopelessness and constraint. For example, Farmer 17 highlighted the importance of getting a vet's contact after losing pigs due to a lack of information on what to do: "We tried to get a vet but it was difficult to find one. [...] So there was nothing we could do and nothing that we tried. [...] Right now, we are in the process of getting the contact of the vet from a nearby village, in case we have any problems". It is important to note that, the competence of getting access to a veterinarian or paraprofessional is bound to other *materials* of the practice, such as the money needed to pay for the vet services, their transport, or the medicines for the animals. Furthermore, veterinarians and paraprofessionals are also part of the *materials* of the practice. They are seen by farmers as the people who can treat or heal sick pigs. This is connected to the influence of other practices, such as general animal disease management, which I will further explain in section 5.2. *The effectiveness of medicine and the assumptions and expectations it creates for ASF Management practice.*

The second *competence* most frequently mentioned by farmers, and as exemplified before by veterinarians' and paraprofessionals' remarks, is selling the sick pig or the meat of the dead pig. This is a response to the *meaning* attached to the practice of trying to not get losses. As Veterinarian 3 explains "They [farmers] know that there is now an outbreak and the first thing that will come to their mind is to sell. They do not mind about how to prevent the infection from entering their farm. They are concerned about selling their pigs and getting their money before they get a loss". While veterinarians and paraprofessionals believe that ASF management is all about avoiding the spread of the disease, and therefore teaching farmers about biosecurity, and controlling their actions, farmers are concerned about keeping the chances of getting some return on investment. The latter implies that instead of having a preventive approach to ASF management by spending money on trying to get the materials to apply biosecurity measures (disinfectant, materials to build a fence, feed for the pigs so that they do not need to roam around), farmers have a reactive approach and try to sell the pigs or their meat to make a profit or not lose money. As Farmer 30 comments "I saw that one [pig] died, so I thought, if I wait, all the other pigs are going to die, so I sold the other seven".

Applying biosecurity measures is a *competence* that farmers could develop to contain the money, as it could potentially prevent the pigs from getting sick. As Veterinarian 2 mentions "You need to explain to them [the farmers] that their pigs will bring them money, much more money than what they need to pay for the service or treatment". However, in the context of rural communities in Uganda, pigs have gained a *meaning* of being quick money, and therefore "biosecurity measures acted as a potential constraint that limited future returns for farmers and their

families” (Thompson 2021:18). Pigs are seen as a small investment with high chances of return, and hence investing in biosecurity measures can be perceived as spending more than wanted or than what they can afford (Thompson 2021). Even getting access to a veterinarian or paraprofessional, or going to the main towns to buy medicine for a sick animal represents an expense for small farmers. As Veterinarian 3 explains “If it is a commercial farmer that has around 100 pigs, the farmer will mobilize. But a smallholder farmer who has 1 or 3 pigs would rather lose the pigs than move to go pick up inputs from town”. This thinking shapes how farmers understand and practice ASF management. Farmers constantly mentioned actions that could be framed as biosecurity measures such as building a fence to prevent pigs from roaming free and getting in contact with infected pigs, in terms of money and not disease management. Building fences was something most farmers aspired to do to avoid having trouble with the neighbors since pigs tend to move around and destroy crops, which consequently implies that the pig gets killed by the neighbor or that the farmer needs to pay for the food the pig ate.

Another *meaning* was also frequently expressed by farmers when discussing dealing with the ASF virus: most of them believe that ASF management is something to be practiced during the dry season. This belief may be related to the perception of ASF as a seasonal disease. It is experienced as occurring every year around the same time, during the dry season, and just like the season comes and goes, so does the disease. Farmer 22 recalls “That [pigs dying of sickness] especially happens in March. It happens every year. Last year seven pigs got sick and they all died. That was the most that have ever died at once”. Few farmers make the connection that letting their pigs roam freely during the dry season exposes them to getting in contact with the virus. They are more prone to associate the cause of the sickness with the sun and the heat. The following quotes from Farmer 5 “We heard rumors from people that the sickness comes with the heat” and Farmer 11 “I’m not expecting so much ASF this year, because it’s a bit cooler this year” illustrate this. Hence this becomes their reality, the dry season will come and most likely many pigs will die, but they will keep buying pigs. To provide an example, the interviewed farmers from one of the villages where a potential ASF outbreak was occurring mentioned that they intended to continue raising pigs, even though they were aware that most pigs would likely die in February each year. One of the farmers further described “Sometimes, during the dry season all pigs die, but then you just replace them in the rainy season”. Farmers believe that during the rainy season, the virus is not around.

The belief that sickness may occur annually during the dry season because of the heat has triggered some farmers to develop some *competences* for prevention. Some farmers mentioned how to try to be more successful with pig rearing they are

making pits to pour water so that the pigs can cool down or taking the pigs to cooler places close to water streams. Farmer 11 has even created a backup plan to cope with this recurrent disease. When describing his experience with an ASF outbreak, he said, "I lost all my pigs and then bought more to start over because I earn a good income from them. Even though I lost all 4 pigs, I was still determined to raise pigs. I save some of the money I earn so that I can buy more pigs in case they die." Though only one farmer explicitly mentioned this, it highlights how new *competences* can develop in response to the various elements involved in the ASF management practice. In this specific example, recognizing that the disease may occur annually encourages the farmer to save a portion of earnings from each pig sold, ensuring there are funds available to replace any pig lost during an outbreak.

5.2 The effectiveness of medicine and the assumptions and expectations it creates for ASF Management practice

Previous experiences when dealing with sick pigs, due to lice, ticks, or other non-specified diseases, and the positive effect of using medication to treat them, have reinforced two main assumptions/expectations that permeate the practice of ASF management in this local context.

The first one is that diseases need to, and can be treated with medicine, be it conventional medicine or local medicine. The following quote from Farmer 16 when asked if she had experienced any problems or challenges with raising pigs illustrates this: "[...] we have been injecting the pigs. A vet came and injected them so that the ticks and lice would stay away. We called the vet because we saw a lot of lice on the pigs. [...] They were healthy aside from the lice though". This quote reflects farmers' assumptions that medicine is a prevention method for keeping pigs healthy, as well as a reactive tool to treat pigs facing health issues. This *meaning* associated with a more general medicine practice is carried to the ASF Management practice. During a group interview with farmers who had temporarily stopped raising pigs, one of the farmers, who had lost 21 pigs in one week due to sickness, said, "I think I will raise some pigs again, even if I start with two. It will be helpful to know the name of the drug to prevent or treat the sickness." This type of comment, expressing the desire to know which medicine to give the pigs to prevent them from dying from ASF, was a recurrent question farmers made to us (the team conducting the interviews) during our conversations. This shows that there is a strong expectation within the community for a vaccine or treatment to manage the ASF virus.

The second assumption is that surveillance is crucial for controlling pig diseases. Several farmers stressed the importance of closely monitoring their pigs to detect any symptoms or health issues. As Farmer 14 explains “We want to be close to our animals, so we become their friends, so that they want to come to us. [...] It also makes it easier to monitor the pig. You quickly notice a difference if something is wrong”. This reasoning creates an expectation that surveillance can lead to prompt disease detection, and consequently to better chances of keeping pigs healthy. The belief that surveillance is a crucial competence for ASF management, is also shared by veterinarians and paraprofessionals. However, as previously described, veterinarians and paraprofessionals referred to surveillance in terms of making follow-ups to see if farmers implement biosecurity measures.

The latter two assumptions make farmers expect that the ASF virus can be handled and contained through the use of medicine and surveillance similarly to how other animal diseases are managed. As farmers experience pigs surviving sickness and assume different diseases might behave similarly when confronted with medicine, an expectation that the ASF virus can be controlled is constantly reinforced. These expectations can create a sense of distrust among farmers and veterinarians and paraprofessionals since they clash with the reality of the virus agency. Although it was not a frequent comment, a couple of farmers mentioned how they thought calling the vet was a waste of resources as the vet had applied a treatment to the pigs but the animals still died. Farmer 31 describes how five of her seven pigs died during a period of time in which her brothers and other neighbors’ pigs were also dying. She expressed her discomfort of reaching out to a vet: “We felt angry so we didn’t call him [the vet] back because it was a waste of money on drugs. I got annoyed by the vet, so I asked some people for advice and they told me to use a local flower”. The local medicine also did not work, so in the end she resorted to the competence of selling some pigs to earn some money.

5.3 The intertwined connections of the elements of the practice

The use of Social Practice Theory has enabled us to identify some significant differences in how paraprofessionals, veterinarians, and farmers practice and comprehend ASF management. While veterinarians and paraprofessionals see ASF management as a way to control the virus and its spread, i.e. containing the virus, farmers practice it as a skill to avoid losing profit, i.e. containing the money. According to Social Practice Theory, the practice is not determined just by the

desires or motivations of the individuals involved, but rather by the connections between the different elements of the practice (Shove et al. 2012). In the case of farmers, constraints with the *materials* (such as difficulties in accessing vets, lack of money to build a fence or implement other biosecurity measures), the lack of knowledge of how the ASF virus operates and spreads, and the *meaning* attached to ASF as a seasonal disease, have gathered up to define the practice in a certain way. Farmers do not have the means to control the virus, they might not even know it is possible to try to control it, hence new *meanings* and *competences* are associated with the practice. The *meaning* of the practice becomes trying to contain the money invested in the pigs and minimize financial losses. The concept of return on investment permeates and drives farmers' decisions, rather than the objective of applying biosecurity measures to control the virus. Consequently, two main *competences* are part of the practice. The first one, highly influenced by the general practice of pig disease management, is contacting a vet to see if the pig can be healed. The second one, trying to sell the sick pig or the meat of the dead pig. Both *competences* reinforce and are reinforced by the *meaning* of trying to invest as little money as possible and get some profit. As mentioned in the chapter before, farmers also have built some expectations towards dealing with the ASF management in which they think the virus can be controlled through medicine. However, due to the other elements of the practice, the continuous connections between the *meanings*, *materials*, and *competences*, farmer's main approach to ASF management does not rely on the implementation of biosecurity measures.

The same interaction between elements shapes the way paraprofessionals and veterinarians practice ASF Management. In this case, the *meaning* of the practice as a tool to contain the spread of the virus is supported by the *competences* of reporting and teaching about biosecurity measures. The constraints on the *materials* previously mentioned such as understaffing, farmers' economic situation, and the *meanings* and *competences* farmers implement in the practice, reinforce the need for the *competence* of surveillance and attempt to control farmers' actions. Farmers' perspective of seeing pigs as quick money (Thompson 2021; Arvidsson 2023) represents a risk in implementing biosecurity measures and strengthens the need for the *competence* of human surveillance. Additionally, the understanding that most of the interviewed farmers have of ASF as a seasonal disease demands the *competence* of teaching them about biosecurity measures. The links between these elements and the virus's intrinsic properties, being highly contagious and with high mortality rates, reinforce the *meaning* that veterinarians and paraprofessionals have of using the practice to contain the virus.

5.4 The virus agency

These intertwined connections between the different elements also show how the virus per se influences the human social world. The virus is a part of the *materials* involved in the practice, and thus, it also impacts the practice and the dynamics built around it. The virus agency, being highly contagious, how it operates with a quick spread, and how it rapidly kills pigs but does not affect human health, among other properties, influence how farmers, veterinarians, and paraprofessionals relate to it. Furthermore, the virus also influences how farmers, veterinarians, and paraprofessionals relate to each other. Viewing the practice from the perspective of veterinarians and paraprofessionals portrays how humans seek to control and exert power over life (Hinchliffe et al. 2013) including the virus. However, the virus also holds power over humans. Due to its ability to remain active for long periods in infected meat, carcasses, and contaminated materials (clothes, vehicles, etc.), veterinarians and paraprofessionals need to monitor farmers' actions to avoid the spread of the virus. Veterinarians and paraprofessionals often describe the need to oversee the disposal of deceased pigs through burning or burial, as well as implement regulations to restrict pig movement. They lack trust that the farmer will follow the recommendations. The virus's actions within this specific context, in combination with the other elements of the practice, promote this sense of distrust among the various actors of the practice. Although it was less prominent in the interviews with farmers, there were also a couple of cases in which they referred to a sense of distrust towards vets. As described earlier, a few farmers mentioned that they considered calling a vet a waste of resources since they had administered treatment to the pig and the pig still died. This is not simply a human-to-human interaction but also a response to the agency of the virus. Due to the characteristics of the ASF virus, treatments aimed at boosting the pigs' immune systems in hopes of helping the pigs fight the virus tend to be ineffective. Hence, when veterinarians and paraprofessionals try to fulfill expectations created around general animal disease management, in which medicine and treatments usually heal the pigs, but the virus still likely kills the pigs, farmers are left feeling uneasy about the vet's efforts.

The virus agency and its influence on human relations can also be seen when considering the competence of reporting and surveillance/control of farmers' actions. Reporting is a human response to a communication path created by the virus. In the case of the ASF virus, pigs show symptoms of sickness, alerting the farmer, who then calls the vet who reports to the DVO. Again, it is not such a human-to-human interaction, but a competence that has evolved from communication with a non-human.

6. Discussion: Trying to control the virus or learning to coexist with it

In the following section, I discuss the findings of how ASF management is practiced in this local context through the lens of a multispecies perspective. I find this study an interesting case that exemplifies both the normalized narrative of biosecurity, one in which viruses need to be governed or controlled, and an alternative approach to the practice in which humans and non-humans coexist. Likewise, it provides a view of how social structures are influenced by the non-human.

When taking into consideration the way veterinarians and paraprofessionals practice ASF management, the concept of biosecurity in terms of creating borderlines between healthy life and diseases is exemplified. Veterinarians and paraprofessionals carry the practice based on the foundation of controlling the virus. This reflects the narrative promoted by FAO that suggests the “concept of a farm as a fortress [...] keeping those inside safe and keeping the “enemy” at bay outside” (FAO 2023:11). Hence, as Hinchcliffe (2013) suggests, the standardized practice of biosecurity operates under rigid boundaries, monitoring the movement of pathogens to prevent them from crossing into “healthy” spaces. The *competences* of reporting and surveillance are a fundamental part of the practice from the view of veterinarians and paraprofessionals. These *competences* go beyond monitoring the pigs and extend into the human world as veterinarians and paraprofessionals think they need to monitor farmers’ actions. They feel that farmers’ actions impede the control of the virus. As a sense of distrust towards farmers’ implementation of biosecurity measures arises, the need for surveillance is reinforced. The latter is an effect that goes beyond human-to-human interaction and is a reflection of the ASF agency. Such as in the case of Blanchette’s (2015) study, in which the entanglement between pigs, virus, and humans in a pig factory influenced the lives of the employees beyond the workplace limits, it can be seen how the ASF virus influences how veterinarians, paraprofessionals, and farmers interact with each other. Blanchette’s research evidenced how human social worlds were being affected by the virus agency and the strict biosecurity measures aimed to tame it, such as in the case of the senior manager who couldn’t socialize outside work with employees. Likewise, in the ASF context, the ASF virus influence goes beyond the effect it has on the pigs and into social dynamics. Veterinarians and

paraprofessionals start distrusting farmers complying with biosecurity measures, and a few farmers start distrusting vets competence in treating pigs' diseases.

When considering the way ASF is managed from the perspective of the farmers another understanding of the practice emerges. Due to the elements involved in the ASF management practice, in this local context, farmers have created a relationship with the ASF virus that is not based on trying to control it, but rather on co-existing with it. All of the interviewed farmers who had experienced the loss of pigs due to ASF, except one, mentioned the willingness to have pigs again. Some of the farmers had already gone through the cycle of losing pigs to the disease and buying new pigs more than once. This may be connected to what previous studies show of how farmers see pigs as quick money (Thompson 2021; Arvidsson 2023), as pigs bring multiple economic benefits, primarily in terms of quickly generating income that can be used mainly to pay for school fees. This constant quest of farmers to keep pigs seeking quick money has made them develop a particular relationship with the virus. When farmers face the ASF virus, they react by quickly trying to sell the pigs or their meat to keep some profit, instead of trying to control the virus through biosecurity measures. It is important to note that this does not imply that this is the way farmers want to raise pigs, it might not even be a conscious choice, but the constraints and conveniences of the context they are embedded in, the elements of the practice described in the findings of this thesis, are shaping how farmers relate to the virus. Farmers have “learned” to and developed a set of *competences* to live together with the virus. This illustrates what Greenhough (2012) emphasizes about how humans can act response-ably when encountering viruses. The term response-ably alludes to the capacity of sensing and responding to non-humans, which can lead to humans shifting from attempting to control non-human worlds to coexisting with them. In the case of this rural local community, farmers sense and react to the ASF virus in terms that do not imply an attempt to control it.

Furthermore, this particular local context illustrates Greenhough's (2012) argument of how the exposure of humans and viruses can lead to an exchange of “gifts”. Although her reasoning is based on the gifts viruses can pose for the human immune system, a similar exchange of information and gifts happens in the interaction between humans and the ASF virus. When farmers come into contact with the virus without attempting to control it, new *competences* emerge. As previously presented in the results, although it was only mentioned by one farmer, Farmer 11 experience is worth highlighting. He has learned to save money whenever he sells some pigs to have as a backup in case any of his pigs die. This is a *competence* that could be included in the general advice farmers receive from veterinarians and paraprofessionals for keeping pigs. The latter exemplifies how, as Hinchcliffe et al. (2013) argue, when we cease to operate under the reasoning of

creating borderlines between humans and viruses, we invite other ideas to the table. The latter does not signify that I argue that farmers losing pigs should be seen as a gift. Instead, I suggest that the gift is the ability to widen the perspective and consider other practical advice that could be provided to farmers once there is greater recognition and acceptance of the inevitable presence of humans and viruses.

In contrast to other scenarios, such as large-scale pork industries, where there is more control over the variables that contribute to the spread of the virus, in the local context of rural households the human ability to control the virus is constantly challenged. The implementation of biosecurity measures based on the premise of creating borderlines to keep healthy lives separated from the disease is harder to follow in this context. Farmers' economic constraints, veterinarians understaffing and limitations, and the local practice of rearing pigs in which confinement of the animals is linked to the season calendars, among other factors mentioned before, challenge the normalized way of relating to viruses. Rural communities in Northern Uganda and the way they practice ASF management reflects the idea suggested by Hinchcliffe (2013) in which biosecurity needs to operate under borderlands, spaces that recognize the fluid dynamics and constant exchange between healthy lives and viruses. As Greenhough (2012) points out, people adapt and create their own ways of negotiating with diseases. I believe this alternative to relate with viruses is worth further exploration. Although farmers do hope for a treatment or vaccine that can avoid having their pigs die from ASF, for the moment, farmers have tailored a practice in which the idea of "accommodating (as opposed to eradicating) viral agency" (Greenhough 2012:295) is applied.

7. Conclusion

This thesis aimed to build upon existing studies of the challenges faced by rural communities that are increasingly raising pigs to improve their livelihoods, but are struggling with outbreaks of ASF. Specifically, the goal was to provide additional insights to complement the analyses conducted by scholars, to better understand the primary issues in implementing and adopting biosecurity measures within these communities. By conducting a Social Practice Theory study to explore how ASF management is perceived and practiced by farmers, veterinarians, and paraprofessionals, significant differences in the execution of the practice were identified. Comprehending that farmers practice ASF management in terms of the ability to quickly avoid losing profit, instead of keeping away the virus, can serve as input when considering how veterinarians, paraprofessionals, and farmers communicate. Most farmers see pigs as a small investment that can bring quick profit and hence, they have developed other skills to deal with outbreaks that go against biosecurity principles. This *meaning* and *competences* attached to the practice are a response of the virus agency as well as to the other materials involved in the practice. Understanding farmers' reality and how this reality is shaped by the connection of different elements, could help ease veterinarians and paraprofessionals' frustration with the failure of farmers to adopt biosecurity measures. Moreover, this awareness might open the door to questioning under what terms farmers should be advised when discussing ASF and what advice is given to them when they get training on pig rearing. It could be interesting to see what outcome can come from framing ASF management in other terms rather than the objective of trying to control the ASF virus.

Comprehending the elements of the practice, and in particular, how farmers practice ASF management served as an interesting setting for a multispecies discussion. The local context has created and provided an example of a scenario in which humans have learned to coexist with the virus, challenging the bigger narrative of humans trying to control viruses. This study and the latter reflections support the possibilities of thinking outside what we have normalized and opening the path to other ways of understanding human and non-human relationships. Even though it's a challenge to think of viruses like ASF as anything other than a threat, I hope this thesis will inspire people to consider other ways to view our relationship

with viruses. What might we discover, and what new skills might we develop, if we don't just see viruses as enemies to be fought off? What possibilities can open up when the starting point is not to see the virus as a threat that needs to be contained or eradicated? Perhaps in contexts where it is not possible to escape from a virus, instead of rowing against the current, efforts could be invested in contemplating the idea of building a relationship with viruses that can lead to an exchange of information that could open new understandings about our world.

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Popular science summary

Biosecurity is the term for measures implemented to protect people and their animals from contamination with harmful substances. Biosecurity is often thought of as measures that ensure human control over these harmful substances, such as viruses. It involves building barriers and systems with strict disinfectant protocols, surveillance, and reporting to prevent healthy life from getting contaminated. But maybe full control over the non-human world is not always realistic? Might we then find other ways to relate to viruses that enable a form of coexistence, acknowledging the impossibility of control? This thesis investigates such situation to learn more about how to think about biosecurity beyond full control. My thesis examined the case of smallholder farmers and animal health practitioners in northern Uganda who struggle with ongoing African Swine Fever (ASF) outbreaks and the adoption of biosecurity measures. My purpose was to understand the relationship between humans and viruses in this context.

ASF is a highly contagious endemic disease that rapidly kills pigs. Due to its high mortality and the lack of a vaccine, biosecurity measures must be implemented to prevent its spread. Animal health practitioners practice ASF management in terms of trying to contain the virus by emphasizing the importance of teaching farmers about biosecurity measures and ensuring their implementation. However, my findings point out that farmers do not practice ASF management in terms of implementing measures to contain the virus. Rather they see ASF management as a skill to contain the money they have invested in the pigs, often resorting to quickly selling sick or dead pigs for profit during outbreaks rather than investing in biosecurity measures.

It can be argued that while animal health practitioners focus on controlling the ASF virus, farmers have learned to coexist with it. Farmers who have experienced the loss of pigs due to ASF are willing to keep pigs again, despite being aware of the risks involved. Although it might not be a conscious choice but the result of the context farmers are embedded in, they have "learned" and developed competences to live alongside the virus. Contact with the virus without attempting to control it can lead to the emergence of new competences. For example, acknowledging that the virus is always present can make farmers save part of the profit of selling pigs

as a backup to restock pigs in case of an outbreak. Once there is greater recognition and acceptance of the inevitable coexistence of humans and viruses, other practical advice and strategies to coexist with viruses can be explored.

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