

Assembling antimicrobial resistance governance in UK animal agriculture

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Abstract

The desire to govern antimicrobial resistance (AMR) in animal agriculture has gained renewed prominence in the UK and international policy and practice in response to growing concern about the impact of AMR infections on human and animal health. This article adopts a more-than-human approach inspired by assemblage and biopolitical thinking to explore *how* diverse actors work to assemble a regime of governance in animal agriculture through their efforts to tackle AMR. How agricultural animals are represented and positioned in this process, and the consequences of these efforts for broader agricultural animal–human relation in UK animal agriculture is also a concern. Qualitative, empirical material is produced from documents published by government, industry organisations, NGOs and retailers. We highlight the negotiated contingencies of actions on AMR in UK animal agriculture and reflect on the limited extent to which they constitute a new front in the regulation of agricultural animals.

KEYWORDS

animal agriculture, antimicrobial resistance, assemblage, biopower, governance

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INTRODUCTION

Antimicrobial resistance (AMR) is a complex public health challenge. The use of antimicrobials creates a selection pressure that can result in previously susceptible infectious diseases evolving resistance to these medicines (Giraud et al., 2019). The rising prevalence of AMR within bacteria is particularly concerning in relation to antibiotics due to the significance of these drugs in treating bacterial infections in modern medicine. Since 2012, AMR has gained renewed prominence in the UK, EU and global public health initiatives, leading to the development of new policies and interventions (European Commission, 2017; HM Government, 2019; World Health Organisation, 2015). The problematisation of antimicrobial use in animal agriculture began in the late 1960s in the UK, following concerns that their mass introduction in the 1950s, to boost animal production and prevent and treat disease outbreaks within industrial farming systems, was selecting for bacterial resistance and enabling bad animal welfare (Kirchhelle, 2018). The renewal of concern in the 2010s has seen animal agriculture become an active site for AMR policy-making and intervention in the UK and elsewhere.

This, however, was not inevitable. As recently as 2014, actors representing UK farming, such as the National Farmers Union (NFU) and the British Poultry Council (BPC), publicly contested the scientific evidence suggesting that animal agriculture was a contributor to the problem of rising AMR in human health and argued that antibiotics are already well regulated in farming, that existing use meets legal and moral obligations to treat sick animals and resisted the need for new interventions (Morris et al., 2016). However, by 2019, following initiatives spearheaded by a coalition of supermarkets, food processors, farming organisations and regulators, sales of veterinary antibiotics for use in animal agriculture had significantly reduced (down 49% from 2014), as had the prevalence of certain resistant bacteria amongst farm animals (Veterinary Medicines Directorate, 2020). As a core component of established practices of animal health and welfare management, the scale of such reductions is suggestive of significant alterations to how antibiotics are being used on farms to prevent and treat disease.

Responding to and informing these developments is an emergent body of social science scholarship on AMR in animal agriculture. Studies have examined farmers' decision-making about antibiotics (Buller et al., 2015; Jones et al., 2015; Schewe & Brock, 2018), and other antimicrobials such as anthelmintics (Bellet, 2018), the current and future role of rapid or 'point of care' diagnostics in AMR governance objectives (Bruce et al., 2021; Chan et al., 2020), the implications of AMR governance for on-farm practices of animal care (Helliwell et al., 2020), the economic and biological drivers of disease and antimicrobial use (Hinchliffe et al., 2018) and the history of antibiotic use in livestock farming (Woods, 2013, 2019). Social science AMR scholarship also includes work that interrogates the discourses and frames circulating within AMR policy and the degree to which these discourses shape roles, responsibilities and interventions. Of particular interest has been One Health discourses and their implications (Craddock & Hinchliffe, 2015; Hinchliffe, 2015; Huth et al., 2019; Kahn, 2016; Kamenshchikova et al., 2021), historical and contemporary national-level policy approaches and the design and enactment of sector-specific antibiotic use policies (Begemann et al., 2018, 2020; Hughes et al., 2021). This is a rich and diverse body of work that we seek to extend through further interrogation of AMR governance across animal agriculture (i.e., rather than in particular sectors). We do this through an approach inspired by assemblage and biopolitical thinking. By doing so, we attempt to open up a more-than-human critical analysis of AMR governance.

Assemblage thinking is a relational, process-orientated, more-than-human perspective. It has gained increased attention in rural studies as a means to critically examine how governance and

policy domains are realised and realise—or not—their objectives and for understanding the emergent nature of situated governance practices and policies (Briassoulis, 2019; Forney et al., 2018; McFarlane & Anderson, 2011). We seek here to extend assemblage thinking through its application to AMR governance in animal agriculture, a biological issue or matter of ‘life itself’. Biopolitical questions and matters have yet to be a significant subject of analysis from an assemblage perspective, and only a small number of works have engaged explicitly with non-human animals in the processes of aqua- and agri-cultural assemblage formation and evolution (see Blanco et al., 2015; Gorman, 2017). By combining insights from assemblage and biopolitical thinking, our aims are to examine *how* diverse actors have worked/are working to assemble a regime of governance across animal agriculture through their efforts to tackle AMR; how agricultural animals are represented and positioned in the process of assembling AMR governance; and finally, to explore to what extent such efforts are opening up a new front in the regulation of agricultural animal lives.

ASSEMBLAGE, GOVERNANCE AND BIOPOLITICAL MATTERS

The concept of assemblage is rooted in the work of Deleuze and Guattari (1988), who emphasise the relational and heterogeneous nature of socio-material formations. Assemblage has emerged recently as a theoretical and conceptual theme in multiple strands of work on rural economies, agricultural governance and food systems (Anderson & McFarlane, 2011; Briassoulis, 2019; Forney et al., 2018). The core contention is that an assemblage approach allows for the delineation of a series of interrelated processes through which stability and meaning are brought to situated governance practices.

Assemblage concepts have been mobilised as a means of (re)conceptualising governance as an emergent, uneven, multiscalar/sited, heterogeneous and decentralised process rather than as linear, top-down and hierarchical (Briassoulis, 2019). A key feature is the recognition of actors who pull together disparate elements without attributing to them a totalising plan or authoritative power (Li, 2007). Assemblage thinking provides an analytic for exploring and elaborating the processual and situated nature of social formations (e.g., an economic system, governance regime, a city, a farm, etc.), the relationships between heterogeneous constituents and how assemblages hold together in some form of provisional unity become territorialised or break apart—become de-territorialised. (De)territorialisation does not necessarily occur in discrete phases but instead is constituted through ongoing simultaneous processes. For example, territorialisation could take the form of new definitions of ‘best practice’ and initiatives to coordinate actors towards said practices. In turn, this can instigate de-territorialisation due to new measures ending previously established practices.

Once assemblages emerge, they are productive agents capable of acting back on the components from which they are formed, generating new practices, actors and so on, enabling and constraining the relations among, and agencies of, their heterogeneous components (DeLanda, 2006; Müller, 2015). Furthermore, an assemblage’s properties and capacities are not aggregations of components capacities/properties but are temporally and spatially contingent characteristics that result from interaction between heterogeneous actors. Consequently, the possibility space of an assemblage, that is, the openings and limitations for action, are non-reducible outcomes of an ongoing process of assembling and cannot be determined a priori. Governance is therefore never settled or complete (although it may be highly durable) and constantly open to re-alignment (Li, 2007).

In summary, assemblage is an ontology of emergence, denoting the assembling of diverse, heterogeneous human and non-human components into a dynamic, contingent and temporary stability to serve a purpose. Diverse applications of assemblage share a common aim to identify and parse the assembling processes of certain governance arrangements over time and space, the inter-related processes and the heterogeneous components through which assemblages act, the how and why of their attempt to direct conduct in particular ways, how they are actively maintained or disintegrate, and how new conditions of possibility may emerge (Bear, 2013; Jones et al., 2019; Li, 2007). In this respect, assemblage thinking shares many of the same concerns and approaches as actor-network theory (Latour, 2005), new materialism (Bennett, 2010), biopolitical (Hinchliffe et al., 2017; Morris & Holloway, 2014) and more-than-human perspectives (Greenhough et al., 2018; Lorimer et al., 2019). Notably, there is an emphasis on the centrality of relations, the active role of non-humans and the distributed nature of power (Forney et al., 2018). However, assemblage is more interested in continuing trajectories of emergent possibilities and future becoming over questions of how a structure is achieved. The concept of 'desire' inserts a fundamental force into the territorialisation of assemblages, which both recognises the individual agency of assemblage actors (not fully acknowledged in Actor-network theory—Müller, 2015), whilst attending to 'the agency of wholes and parts, not one or the other' (McFarlane & Anderson, 2011, p. 63). This foregrounds how individual actors engage in and with the assemblage in attempts to direct its trajectory, but specific outcomes are the contingent and emergent result of actors in relation to diverse desires and never fully match individual plans (Forney et al., 2018).

Our application of assemblage thinking draws on the influential framework of Tanya Li, who advances a Foucauldian-inspired assemblage analytic to explore the practices, processes and rationalities of community forest management in Indonesia (Wynne-Jones & Vetter, 2018). Li (2007) outlines six practices of assemblage: (1) forging alignments, (2) rendering technical, (3) authorising knowledge, (4) managing failures, (5) anti-politics and (6) re-assembling. Li's analytic attends to some of the previously neglected aspects of governance. However, 'governance' is not a generalisable structure, nor does Li's framework attend closely to the ontology, that is, the nature of what is being governed. We therefore take this framework as our starting point. To sharpen its analytical focus on the issues of interest to this article, we have introduced biopower with its focus on the regulation and fostering of life. Although originally concerned with the regulation of human populations, subsequent theoretical developments have extended the scope of the biopolitical lens to include more-than-human accounts of the regulation of life, including agricultural animals (Hinchliffe et al., 2017; Holloway & Morris, 2012; McGregor et al., 2021; Morris & Holloway, 2014). Conceptually, these developments have been necessary given that non-human animals are essential constituents of and agents within animal-based agricultural systems. The regulation of animal health and welfare has been a particularly significant topic of empirical focus for biopolitical work, including literature on biosecurity measures (Enticott, 2016; Enticott et al., 2012; Hinchliffe, 2013; Hinchliffe et al., 2017), on-farm practices of antibiotic use (Helliwell et al., 2020) and animal welfare assessments (Buller & Roe, 2014; Hinchliffe et al., 2017) examining the heterogeneous co-constitutive processes of regulating animal health, bodies and agencies.

Biopower takes specific forms in particular moments, geographies and cases (Holloway et al., 2009). We therefore draw on the work of Rabinow and Rose (2006), who provide an analytic for framing 'moments of biopower'—notably that the problem to be governed is a 'problem of life itself', attention to the establishment of truth discourses and authorities who speak these truths, strategies for intervention and subjectification wherein individuals come to work upon themselves aligning their behavior and practices with the truth discourses. Specifying these dimensions

TABLE 1 Dimensions of assemblage analytic

1. Establishing truths	The emergence of the ‘desire(s)’ to steer or ‘will to govern’, problematisation of the governance issue and domain of action it specifies
2. Forging alignments	The work of connecting, coordinating and excluding heterogeneous actors, determining roles and responsibilities and enabling and constraining relations, including with other governance assemblages
3. Specifying the object of governance	Specifying the problem of life as the object of and thus the scope of governance
4. Rendering technical	Extracting from the messiness of the social world a set of relations that can be formulated, made visible through authorised knowledge and thus actionable to meet the objectives of the assemblage
5. Subjectification	The capacities of the assemblage to subjectify its constituent actors to work on themselves to achieve its objectives
6. Reassembling	Grafting on, gathering-up and reformatting existing discourses, interventions, and initiatives in the context of the emergent assemblage
7. Future possibilities	As assemblages are constantly in the process of being territorialised and deterritorialised what can be said about the future of AMR governance in animal agriculture—its future possibility space

sensitises our analytical gaze to an explicitly biopolitical matter within the assembly of AMR governance in animal agriculture.

Table 1 describes how we have adapted Li’s practices of assembling analytics by introducing biopolitical concepts and concerns (e.g., establishing truths, specifying the problem of life as an object of governance, subjectification) as well as concepts from the wider assemblage literature that are given less explicit emphasis in Li’s work (e.g., future possibilities). Each of these dimensions is elaborated, in turn, in the empirical section below.

METHOD

A systematic review of key documents and reports relevant to AMR and antibiotic use in UK animal agriculture provides the empirical core of this article, an established approach with regard to assemblage and biopolitical analysis (Bear, 2013; Holloway & Morris, 2007). To compile a corpus of relevant publications, a list was drawn up of UK organisations known by the researchers to be concerned with the topic of antibiotic usage in livestock. These organisations included government (e.g., Department of Environment, Food and Rural Affairs [DEFRA], Department of Health and the Food Safety Authority), agricultural industry (e.g., Responsible Use of Medicines in Agriculture [RUMA] Alliance, NFU and Agriculture and Horticulture Development Board [AHDB]), retail (major supermarkets and food processors) and non-governmental organisations (NGOs), for example, Soil Association and Alliance to Save Our Antibiotics (ASOA). Internet searches were then performed to find documents published by these organisations between 2000 and 2019 concerning antibiotic use and AMR. The references within these reports were then followed up to

further build the corpus until the point at which no further reports could be identified. The final corpus was 181 documents, 60 of which were from government sources, 69 from organisations representing the UK agricultural industry, 31 were from NGOs and the remaining 21 were from the retail sector. These documents were then reviewed by the research team and refined further to 64 documents (19 government, 19 agri-industry, 17 NGOs, eight retail) for coding and analysis. The full list of documents is provided as supplementary material. The retained documents were those that engaged with the rationale, policies, practices, actors and infrastructures of AMR governance in animal agriculture. Rejected documents were those primarily focused on other topics and made no substantive mention of AMR governance in animal agriculture beyond recurring 'statements of fact', for example, AMR is a threat to human and animal health.

Relevant text within the 64 documents that pertained to AMR governance in animal agriculture was identified using the search terms 'animal', 'animal health', 'animal welfare', 'livestock' and 'agriculture'. This helped exclude text relating specifically to AMR governance in human health. The remaining sections of text were then closely read and thematically coded according to the analytical lens described in the preceding section. Quoted material is indicative of broader themes in the data and selected with the aim of presenting quotes from a breadth of sources.

ASSEMBLING AMR GOVERNANCE IN UK ANIMAL AGRICULTURE

Establishing truths

The desire, or will, to govern AMR in the UK has been and continues to be driven by public health concerns. The chief medical officer's (CMO) team was key to forging a renewed will to govern AMR amongst heterogeneous actors, with an instigating moment arising with the publication, in 2013, of the CMO's report *Infections and the rise of antimicrobial resistance*. Rather than continuing the 'health of the nation' approach, this report breaks with tradition by adopting a particular thematic emphasis and is both a collection of evidence and explicit advocacy for action on AMR. Notably, the report positions itself as starting a period of concerted political advocacy and awareness building on AMR by the CMO's office. The re-emergent desire to govern is explicitly associated with the materially evolving nature of AMR. Specifically, 'A characteristic of infectious disease which separates it from other types of illness is that the causative factors undergo constant and rapid change. ... as we develop new prevention and treatment options, so the microorganism can evolve resistance mechanisms to defeat us' (Chief Medical Officer's Office, 2013, p. 13). Ongoing processes of bacterial evolution have reshaped the AMR 'problem' and our experience of it.

Considerable work has been required to enrol animal agriculture in the AMR governance assemblage. The problematisation of AMR as a governance matter for agriculture has been a long-standing and contested topic. Present in the UK government's first *UK 5-year Antimicrobial Resistance Strategy 2013–2018* (DoH & DEFRA, 2013) were questions about the degree to which antibiotic use in animal agriculture was a contributor to AMR in humans. However, less than 4 years later, resistance to new measures had evaporated, with farming organisations having taken on a leadership role in governing AMR (RUMA Alliance, 2017).

Key to this shift is the establishment and routinisation of a new truth discourse. Importantly, this is not based on the scientific claim that antibiotic use in agriculture is linked to AMR in humans but a normative claim of *shared responsibility*. The nature of the problem is itself

important here. Particularly, the shift from a concern for specific hospital-acquired AMR bacteria, such as methicillin-resistant *Staphylococcus aureus* (MRSA), which situated governance within human clinical settings, towards an emphasis on a broader trend of rising AMR prevalence across a wide range of bacteria and settings. Thus, responsibility for action must extend across diverse users of antimicrobials.

Ensuring that antibiotics are used responsibly and less often will not happen overnight. ... Everyone has a responsibility and a role to play in making this happen. (DoH & DEFRA, 2013, p. 7)

Present in the CMO's 2013 report, the truth discourse is then reproduced through a myriad of national and international strategies and policy documents, including the 5-year AMR strategy published in 2013 by the UK's Department of Health and DEFRA (2013), the high profile and influential O'Neill (2016) Review published in sections between 2014 and 2016, and the 2019 UK AMR national action plan (HM Government, 2019). Further, the World Health Organisation (WHO) mobilises a concept of One Health to both indicate that AMR is a multifaceted issue and that it requires action to be distributed among human, animal and environmental actors (World Health Organisation, 2015).

The potency of this truth discourse in forging alignments between heterogeneous actors is demonstrated in a 2013–2014 House of Lords Select Committee hearing on AMR that saw the CMO, Sally Davis, and the chief veterinary officer, Nigel Gibbons, provide evidence together. During the hearing, Gibbons repeatedly contested the science regarding the contribution of agriculture to AMR as a problem in human health, and yet in each instance, he accepts the shared responsibility to act.

However, I do not want to give the impression that I and Dame Sally are separate on the importance of dealing with [antibiotic] use in animals as a potential driver for antimicrobial resistance. (CVO Nigel Gibbons speaking to House of Lords: Science & Technology Committee, 2014)

Once accepted, this truth discourse closes down space to contest the necessity of action on AMR in animal agriculture.

The O'Neill Review (2014–2016) is also significant in the UK context, as it became a crucial authority in positioning farmers, veterinarians, supermarkets, processors and regulators as holding key responsibilities to act as part of a broader programme of AMR governance (Hughes et al., 2021). The result was the growth of considerable momentum around AMR governance. The executive summary of the first *Veterinary Antibiotic Resistance and Sales Surveillance* (VARSS) report published by the Veterinary Medicines Directorate (VMD), an executive agency of DEFRA responsible for animal medicine licensing and regulation, highlights this:

2016 has been a year of building momentum, reaffirming and updating old commitments, and making new ones. (VMD, 2016, p. 16)

The *will to govern* AMR in ways that expanded responsibility to encompass human, animal and environmental dimensions had a new national and international intensity that had fundamentally changed the governance landscape.

Now entangled in an emergent AMR governance assemblage, livestock farmers needed to be seen to be acting to govern AMR; otherwise, they would potentially face the blame for an outbreak of AMR infections. As the first RUMA Alliance *Targets Task Force* (2017, p.3) report notes:

The last 18 months have seen UK farming rise to the challenge and take a leadership role in the critical matter of antibiotic use, and it fully intends to play a key part in the global One Health fight to preserve the efficacy of our most valuable medicines.

By 2017, the truth discourse had become internalised by actors within animal agriculture who continue to be central to the AMR governance assemblage as we elaborate below.

Forging alignments

The CMO team was key to forging initial alignments within the UK government; for example, meeting with DEFRA officials to persuade them to put AMR on their strategic risk register for the department (Chief Medical Officer's Office, 2013, p. 16). However, territorialising the assemblage to govern AMR requires defining, coordinating, enabling and constraining the roles and relationships of diverse actors. For example, the UK government has enabled constrained and coordinated relations between actors, including between its own agencies and departments. The breadth of this co-ordination is highlighted in the 2014 *Progress report on the UK 5-year AMR strategy*:

Public Health England (PHE), Defra Veterinary Medicines Directorate (VMD) and Department of Health (DH) are leading work [on AMR] with the Department for Business Innovation and Skills (BIS), the Foreign and Commonwealth Office (FCO), the Department for International Development (DFID), the devolved administrations, the National Institute for Health and Care Excellence (NICE), expert advisory groups and key commissioning and delivery partners including National Health Service (NHS) England, Health Education England (HEE), Medicines and Healthcare Products Regulatory Agency (MHRA), NHS Trusts, Clinical Commissioning Groups, general practice, as well as the local Government community, social care organisations, professional bodies for both human and animal health sectors, the Research Councils and academia. (DoH, 2014, p. 7)

This co-ordination is particularly prominent with regard to research funding, arguably a means of de-politicising the role of the government by translating the issue into a funding allocation/scientific problem.

Although the UK government has established high-level objectives on AMR in agriculture, it has made agricultural industry organisations responsible for the design and implementation of policies to achieve them (Begemann et al., 2020). State steer on this issue is made clear in RUMA Alliance's (2017, p. 2) first AMR Taskforce report:

RUMA also held its first conference that November of 2015, at which it received a clear steer towards the need for action on the use of antibiotics in agriculture. Six months later, RUMA, which spans every animal agriculture sector and every stage of the food chain, had taken decisive, proactive action before farming found itself regulated with unwieldy or inappropriate constraints.

Umbrella organisations such as RUMA and the Food Industry Initiative on Antimicrobials, composed of agricultural industry organisations, farmer unions and veterinary associations, food processors, retailers, pharmaceutical industry organisations, some food, consumer and environmental NGOs, and government institutions as advisors and observers, have become particularly influential in designing, coordinating and facilitating the adoption of new antimicrobial use practices.

One outcome has been the formation of clusters or ‘stewardship groups’ seeking to steer the assemblage towards specific practices.

“This has resulted in the creation of multiple sector stewardship groups, which have allowed representatives from across the industry to share best practice and improve responsible use of antibiotics, as well as infection prevention and control.” (RUMA Alliance, 2020, p. 2)

“The AHDB is actively engaged with livestock farmers, vets and supply chain stakeholders in building sustainable animal health and encouraging the responsible use of all medicines to ensure good health and welfare of farmed animals.” (AHDB Beef & Lamb, 2017, p. 1)

Reporting on progress implementing antibiotic stewardship initiatives, the RUMA Alliance (2017) notes how this also gives ownership to these actors. The AMR governance assemblage therefore enables farmers to undertake ‘voluntary’, self-disciplinary action to reduce antibiotic use, action that has been successful both in reducing antibiotics and preventing legislative changes. However, although farmers and veterinarians are nominally the bottom-up owners of AMR governance, state institutions have been key in initiating action and establishing the objectives that these organisations and ultimately farmers have become responsible for meeting. The UK government’s will to govern AMR, its objectives and the relations it has forged to realise them undergirds this bottom-up ownership. Furthermore, although ‘voluntary’, these actions have been operationalised through contractual agreements between supermarkets and farmers and through assurance schemes (e.g., Red Tractor). AMR governance therefore also involves the (re)assemblage of existing procedures, technologies and forms of assessment to enact new obligations on antibiotic use and monitoring.

In contrast, other actors are constrained in their imagined and actual ability to act on and through the assemblage. ‘The public’ is positioned into predefined roles ‘as patients, consumers, animal owners and investors’ (HM Government, 2019, p. 8), for whom greater ‘awareness’ and ‘understanding’ are situated as contingent requirements for action in agriculture and healthcare sectors. It is only as consumers that publics are (weakly) framed as political actors able to apply ‘pressure’ on the food industry to improve animal health and welfare and through being willing to pay higher prices to support low antibiotic-use production systems (ability to pay is not acknowledged explicitly).¹ The Plofkip campaign, a Dutch initiative to improve animal health and welfare in intensive poultry farming, is provided as ‘a remarkable example of supermarkets and industry accepting consumer pressure to improve animal health and welfare by partly reversing a key aspect of modern intensive poultry production’ (ASOA, 2017, p. 14). In sum, the mechanism through which ‘the public’ can shape the assemblage is limited to the market in their role as consumers.

Civil society organisations and campaigning NGOs are also largely absent. Where they are enabled within the assemblage, it is as handmaiden organisations. For example, NGOs, together

with government, processors and retailers, are invited to consider and support a set of ‘ambitious proposals’ from the pig industry designed to

(a) achieve significant antibiotic use reductions, whilst taking due regard of the health and welfare of the pigs, and avoid creating a competitive approach to antibiotic reduction. (RUMA Alliance, 2017, p. 39)

Alternatively, some NGOs are situated similarly to ‘the public’ as influencing AMR governance through an economic, consumption-oriented role rather than a more overtly political role. Technologies and practices of farm assessment are particularly important. NGO food assurance schemes such as Freedom Food (ASOA, 2015) and the Royal Society for the Prevention of Cruelty to Animals assured salmon (Lidl, 2019), for instance, become another means through which supermarkets and consumers can support action on antibiotic use and shape farm practices. Low antibiotic use is in turn rendered as an economic ‘good’ to be commodified and sold. NGOs also appear in the form of a variety of professional organisations, learned bodies and charitable funders of research able to support/be involved in AMR research as partner organisations. Again, this role is largely technical rather than political.

In contrast, campaigning NGOs such as the ASOA are recognised but not widely discussed. Defined as ‘an alliance of [65] health, medical, environmental and animal welfare groups working to stop the overuse of [65] antibiotics in farming, ... [ASOA]... was founded by Compassion in World Farming, the Soil Association, and Sustain in 2009 and is supported by the Jeremy Coller Foundation’ (ASOA, 2014, p. 1). In contrast to many of the actors we have highlighted, the ASOA presents an explicitly systemic problem and solution framing of AMR in animal agriculture and has been present in media discourses on AMR in agriculture (Morris et al., 2016). Central to ASOA governance claims is that AMR is another manifestation of industrial forms of agricultural production and that there is a need to forge new types of alignments between humans, bacteria and animals. It is through engaging in a public debate that the ASOA attempts to shape the capacities and trajectory of the assemblage with unclear success.

The AMR governance assemblage is therefore dominated by incumbent policy, research and industry-aligned organisations who are enabled to act on and through the assemblage. In particular, an effort is made to constrain the ability of the public (positioned as consumers of animal-based foods and antibiotics as companion animal owners) and civil society organisations to place political demands on AMR governance and animal agriculture more broadly. Furthermore, the work of forging alignments as undertaken by dominant human actors leaves invisible the roles and capacities of agriculture animals and other non-humans within the assemblage.

Specifying the object of governance

Once AMR becomes stabilised as a matter of responsibility for animal agriculture, there are multiple problems of life that could be specified as the ‘objects’ of governance. This process of specification is significantly impacted by which actors are enabled and constrained within the governance assemblage.

It is antibiotics that have been positioned as the central object of AMR governance as revealed in the 2016 VARSS report with its question ‘how appropriately low is possible for antibiotic use?’ (VMD, 2016, p. 15). This is not without just cause. The problem of life and the increased prevalence of AMR are linked to evolutionary selection pressures that result from antibiotic use.

However, achieving reductions in antibiotic use is not straightforward. Antibiotics are used to treat sick animals. Reducing use therefore goes hand in hand with their re-entrenchment as necessary technologies to be used responsibly by veterinarians and farmers.

Livestock producers have a responsibility to protect human and animal health by using antibiotics responsibly in order to minimise the risk of antibiotic resistance (AMR). (AHDB Beef & Lamb, 2019, p. 2)

Although there are certainly economic and productivity concerns at play, AMR governance intersects with both a legal obligation and a deep seated cultural and professional expectation that farmers will give antimicrobial care to sick animals. However, these tensions do not translate into animal health (and its improvement) being specified as the problem of life and the object of governance. As such, a focus on antibiotics renders animals less visible in the assemblage.

Alternative objects of governance could, however, have been specified. For example, specific AMR bacteria could have been designated as a notifiable disease. Norway has followed this rationale with regard to MRSA in pigs, where a policy of biosecurity controls, surveillance and culling of MRSA-positive pigs has been enacted (Norwegian Veterinary Institute & Norwegian Institute of Public Health, 2021). Although politically and practically possible, the presence of specific AMR pathogens on/within animal bodies as the problem to be governed is made problematic due to the biological slipperiness of AMR. Unlike other notifiable diseases, many AMR pathogens of concern, such as MRSA and extended spectrum beta-lactamase *Escherichia coli*, are commensal bacteria that can live harmlessly on and in human and non-human animal bodies without causing clinical issues. AMR genes are also often mobile and can be transmitted between different bacterial species, including between pathogenic and non-pathogenic commensal and environmental bacteria. Notifiable status was considered in the UK but rejected, as a document from 2012 reveals, due to the need for culling.

Culling animals as a means of controlling antimicrobial resistance will be perceived with mixed opinions by society as a whole. (DARC & ARHAI, 2012, p. 68)

This guidance document goes on to elaborate a broader case against excessive AMR control measures that includes the negative economic, trade and public health impacts that might result.

One group of actors, the ASOA, makes the case for another governance object. Their proposal centres the animal-human-biological relations that result from systems of production and notably the breeding of animals for only productive traits:

The resulting health issues arising from such conditions, such as respiratory illness, lesions and cardiac problems, typically require flocks to be routinely medicated with antibiotics. (ASOA, 2016b, p. 5)

Cows should be bred for robustness and good health, rather than for high levels of production. Dairy cattle breeds selected primarily for high milk production are more likely to experience metabolic and physiological stress, which can impair immune function. (ASOA, 2016a, p. 3)

For the ASOA, the problems of AMR in animal agriculture cannot be bounded so neatly as to only involve the relationship between antibiotics and bacteria or the presence or absence of

AMR bacteria. Positions that make invisible/less visible agricultural animals themselves. Instead, systems of production are connected explicitly by ASOA to animal bodies bred to facilitate productivity goals and short production timelines, which in turn create disease vulnerabilities requiring excessive antimicrobial use. One consequence of this framing is that the animal is made visible, presenting an opportunity for animals ‘themselves’ to become an object of AMR governance, with all this might suggest for reassembling agricultural animal bodies and systems more broadly. For ASOA, antibiotic reductions are to be commended, but without systemic solutions, including new animal breeds and systems of production, AMR governance will not address the underlying animal-human relations that are the cause of the problem. The lack of authority of these actors within the assemblage means that their position has not had any discernible impact in defining practical interventions.

Rendering technical

Once antibiotics have been specified as the object of governance, the question of *how* to reduce their use becomes a technical problem. Data, specifically the quantification and surveillance of antibiotic sales, are situated as the foundation from which other capacities of the assemblage can be established.

... there is a clear need for more robust data on how antimicrobials are used to improve our understanding of the links between animal health and welfare, productivity, drug usage and resistance and to provide the evidence we need to design effective interventions and controls. (HM Government, 2019, p. 60)

Making visible antibiotic use through the better collection of relevant data is expected to enable subjectification of farmers and veterinarians, specifically by fostering their understanding of how they need to change their behaviour to reduce antibiotic use.

However, the legacy of past (in)action on antibiotic use and AMR is that there is a significant data gap. Antibiotic-use data have historically only been collected in relation to aggregate national sales. To address this, the VMD has begun to annually publish the VARSS reports. These reports have become an important object through which the assemblage presents ‘numerical “facts” ... to order and rationalise problems, settle uncertainties, and govern the social’ (Begemann et al., 2020, p. 2). VARSS reports are not only technical documents but also include annual statements from farming organisations on their progress, failures and recommitment to governing AMR and antibiotic use. These statements highlight the role of these reports in (re)territorialising the governance assemblage as actors (re)commit to the work of AMR governance for another year.

Rendering antibiotics technical is not straightforward. Aggregate antibiotic sales data provide an opaque picture of sector-specific practices because many antibiotic classes and products are licenced for multiple species. Consequently, there is a desire to develop sector-specific data. However, segregating each livestock sector into a contained entity and then extending surveillance within it rests upon certain types of structural and economic orderings.

Each sector’s starting point was very different. The poultry meat sector’s stewardship programme has been in operation since 2012 and its highly integrated nature aids communication and collective action; whereas the sheep and beef sectors, with high numbers of producers and more fragmented supply chain but generally lower levels

of antibiotic use, have had to identify key ‘hotspots’ to tackle. (RUMA Alliance, 2017, p. 3)

One consequence of this is that it is harder to collect data from/on the dairy and especially the beef and sheep sectors, in part because their farms often rear multiple species simultaneously and because there are few antibiotics exclusively licenced for sheep (Doidge et al., 2020). The utility of antibiotics for treating diseases across different animal species becomes a problem for rendering sector-specific antibiotic use visible.

[some beef] farms were excluded from the sample due to the presence of sheep. These are excluded because it is not possible to determine for which species products licenced for cattle and sheep have been used. (VMD, 2020, p. 43)

Sheep farming is not covered by the antibiotic sales data presented in the VARSS reports, whilst only 9% of UK beef farms are covered. This contrasts with 34% for the dairy sector and approximately 90% for the poultry, pig and fish sectors (VMD, 2020).

Data are also important for delineating the relationship between antibiotic use and the prevalence of AMR in animal agriculture *and* the significance of this activity to AMR impacting humans.

This should include a transparent review into the state of antibiotic use in agriculture and its relationship with patterns of anti-microbial resistance. (Compassion in World Farming, 2011, p. 5)

A more accurate picture of how widespread ESBLs are in animals, and the dominant types present, will be important in determining the significance of animal reservoirs as potential sources of transmission to humans. (DARC & ARHAI, 2012, p. 34)

According to these statements, there is a need to extend surveillance by creating new obligations for veterinarians and farmers to take and test samples from ill and healthy animals and to enable specific AMR pathogens to be brought into the gaze of established animal disease surveillance. However, with AMR pathogens not being specified as the object of governance, these practices rely on existing practices of voluntary submissions by private veterinarians and slaughterhouse sampling (VMD, 2020).

Data are not only a means of ensuring that targets for antibiotic reduction are met. Antibiotic reductions potentially risk eroding animal health and welfare. This has been and remains a prominent concern amongst farmers, veterinarians and industry representatives (Buller et al., 2015; Morris et al., 2016) actors that are centrally involved in the AMR governance assemblage. However, despite the political nature of these concerns, they have become rendered a technical issue requiring existing data synthesis.

The group will monitor available metrics of national cattle health and welfare alongside antibiotic use data to ensure reductions in antibiotic use are not impacting negatively on health and welfare. (RUMA Alliance, 2018, p. 11)

The risk to animal health and welfare is captured by existing metrics, which becomes a data point against which antibiotic use reductions can be correlated and compared.

Subjectification

A notable feature of AMR governance in animal agriculture is the absence of new statutory requirements, legislation or explicit disciplinary mechanisms. VARSS data collection and reporting are based on established statutory instruments such as the 2005 Veterinary Medicines Regulations, which mandate the collection of sales data on antibiotic veterinary medicinal products (VMD, 2019). The government's principal demand has been for the industry to create the frameworks and initiatives required so that farmers and veterinarians work on themselves 'voluntarily' to reduce antibiotic use. Although the AMR governance assemblage appears, in specifying antibiotics as the object of governance and rendering them technical, to act along very narrow lines (Begemann et al., 2020; Hughes et al., 2021), a broader programme of subjectification is also extended through and by the assemblage. Consequently, the capacities of governance are also shaped by the ability of its constituent, heterogeneous actors to work on themselves in relation to other assemblage elements to address the key problem of life in this context.

Organisations such as RUMA and the Food Industry Initiative on Antimicrobials have created the forum through which diverse actors have negotiated a set of collective principles, targets and responsible antibiotic use standards. These new measures also gather up and reassemble existing voluntary food assurance schemes that include antibiotic measures (Red Tractor, the Lion Scheme for eggs) and other initiatives on AMR, such as the BPC and National Pig Association antibiotic stewardship programmes, started in 2011 and 2016, respectively. Collectively, these programmes, through their assessment procedures, aim to shape the actions of farmers and veterinarians who are expected to do the work of becoming good antibiotic stewards with both a legal duty to 'safeguard the health and welfare of animals on their farm' (RUMA Alliance, 2014, p. 2) and 'to protect human and animal health by using antibiotics *responsibly* in order to minimise the risk of antibiotic resistance (AMR)' (emphasis added, AHDB Beef & Lamb, 2019, p. 2).

One outcome has been the reframing of farmers from being implicated in excessive 'misuse' and 'overuse' of antibiotics (Begemann et al., 2018) to being 'stewards' of a common resource, involved in an initiative of antibiotic stewardship to manage animal health and the efficacy of antibiotics now and for the future. A good antibiotic steward is therefore a farmer and/or vet involved in adopting a wide range of measures to prevent and more effectively manage animal sickness when it does occur as well as benchmarking their progress against others. Realising these new obligations and responsibilities requires awareness raising amongst the farming community and for farmers to improve their livestock management practices through formal training and exchanging knowledge with veterinarians.

It is important that people working with animals can recognise when health problems occur and that they use veterinary medicines correctly. Staff working with animals need to be skilled stock-people in assessing animal welfare and in the administration and safe use of veterinary medicines. Training should be provided where required. (RUMA Alliance, 2015, p. 26)

we expect farmers and veterinary surgeons to work together ensuring healthy animals and responsible use of medicines. (ASDA, 2019, p. 1)

This quotation reveals how veterinarians, alongside farmers, are another actor being 'responsibilised' and are expected to work on themselves to realise antibiotic reduction objectives.

Statistical evidence suggests that the outcome of this work has been very successful in quantitatively reducing antibiotic use, including in the category of Highest Priority Critically Important Antibiotics (HPCIA). However, the capacity of heterogeneous actors to act on themselves is shaped through the relations farmers and veterinarians have with other assemblage elements, many of which remain unchanged. For example, intensive farming systems and the productivity logics that drive them to remain unchallenged, prioritisation of animals bodies bred for productivity and fertility not health, legal structures surrounding antibiotic use are the same and no new initiatives to improve animal health have been actualised. Instead, antibiotic stewardship has largely remobilised existing voluntary programmes. Sales of veterinary antibiotics for use in food-producing animals have plateaued between 2017 and 2019 (VMD, 2020), highlighting both these limitations and that further antibiotic reductions might be more challenging.

At the same time, the additional pressure to reduce HPCIA has resulted in farmers switching to alternative treatments and often older antibiotic classes that require a larger dose of active ingredients to treat an animal. In contexts where there has not been an improvement in the incidence of animal disease, the result has been increased quantities of antibiotic use.

While use of colistin [a HPCIA] ... continues in some parts of Europe, in the UK, affected [sick] pigs have instead been treated with zinc oxide or lower priority antibiotics like “aminoglycosides,” said Paul Thompson, president of the Pig Veterinary Society. (Wasley et al., 2021)

This apparent contradiction can, however, be resolved by framing these increases in antibiotic use as responsible because they align with wider moves within the AMR governance assemblage to subjectify farmers and veterinarians as ‘responsible’ users of antibiotics when treating sick animals. Made invisible is the wider system of intensive practices that place pressure on animal bodies, in this case, sows, bred to produce ever-bigger litters, subsequently reared in large groups. Both practices leave the young and adult pigs vulnerable to infection.

Reassembling

Antibiotic use is principally concerned with production diseases, the endemic diseases for which animals routinely receive treatment. Subsequently, AMR governance reassembles many existing and well-established discourses, disease prevention and management practices of animal health and welfare under the auspices of facilitating antibiotic stewardship. This includes biosecurity, preventative disease management, infrastructure improvements, good animal husbandry and stockperson skill, herd health planning, nutrition, training and knowledge exchange, quarantine of purchased animals and vaccination. That AMR governance might be a means of mobilising the adoption of these broader measures is largely rhetorical, contingent on the subjectification of farmers and veterinarians. However, our relations with antimicrobial chemicals, although reassembled with regard to specific uses, remain fundamentally undisrupted. Whilst AMR is a problem exacerbated by the use of antimicrobial chemicals, AMR governance re-entrenches its necessity. These are still chemicals to be used by humans to achieve a mix of imperatives related to animal care, producing productive animal bodies and controlling undesirable pathogenic life. In this respect, AMR governance highlights the difficulty of moving towards modes of more-than-human relationality with more troubling and threatening forms of life.

In addition to reassembling broader programmes of animal health and welfare, AMR governance also aspires to reassemble the farm. The UK's 2019 5-year action plan for AMR articulates these aspirations. It anticipates that through antibiotic stewardship, there are opportunities to transition to 'high health production systems that result in healthier, more productive animals...' (HM Government, 2019, p. 39). This resonates with assumptions outlined in the previous 5-year AMR strategy (DoH & DEFRA, 2013) and mobilises a long-standing policy association between responsible medicine use, good animal husbandry, disease prevention, biosecurity and high animal health and welfare (see DEFRA, 2004). Governing AMR is therefore imagined as a means of reshaping farms and farming towards new possibilities. Such reassembling rests on the assumption that antibiotics are a key technology sustaining existing systems. Therefore, by disrupting existing levels of antibiotic use, farm systems and animal-human relationships will need to be reassembled. However, the actual means through which these measures will be realised is deeply ambiguous. Indeed, historical and contemporary research suggests that the relationship between antibiotics and the development and persistence of intensive production systems is more nuanced and complex than is often assumed (Helliwell et al., 2020; Woods, 2019).

Future possibilities

The previous sections have examined the assembling of AMR governance in UK animal agriculture. This section addresses future possibilities and the opportunities to re-/deterritorialise the assemblage. Our analysis has highlighted several points of cleavage/leverage through which the assemblage might be shifted onto new trajectories. These include a changing social-political milieu, specifying different objects of governance, changing roles and responsibilities of diverse actors and the establishment of new truth narratives.

Some possibilities have already been alluded. The problematisation of the object of governance highlights how the possibility space of the assemblage contains/ed multiple possible forms related to the specification of different objects of governance, only one of which has been actualised at present. For instance, AMR, as a constantly emergent phenomenon, could result in the development of different AMR genes and pathogens of concern. As we have noted, this was a key instigator of renewed collective action on AMR in the UK and could result in a revisiting of previous decisions, including whether AMR bacteria remain non-notifiable. Such possibilities might, as the Norwegian pig MRSA example highlights, require the establishment of new truth discourses and authorised knowledge that more closely connects specific AMR bacteria prevalence in animal populations with human health risks. Such a decision would result in significant reterritorialisation of the assemblage so as to expand the scale and scope of bacterial sampling on farms and bacterial identification and antibiotic sensitivity testing of such samples. Furthermore, AMR governance has categorised a number of antibiotics as HPCIA, which have been targeted specifically for major reductions in animal agriculture. Subjectification of farmers to these logics of antibiotic prioritisation has meant they have often turned to older antibiotics in lieu of using HPCIA. If the HPCIA category was to be expanded further, this would limit farmers' ability to access important antibiotic classes. Meanwhile, the evolutionary nature of the phenomena might mean that AMR infections make the treatment of routine diseases increasingly costly and difficult for farmers. In both instances, the assemblage might reterritorialise in new ways that more fundamentally challenge the modes and logics of antibiotic-use practices in animal agriculture.

Notable possibilities are opened by the changing socio-political milieu and its implications for UK agriculture resulting from coronavirus COVID-19 and Brexit, in particular the implications

of new trade relationships. The desire to govern AMR was initiated by the pre-Brexit Coalition government between the Conservatives and Liberal Democrats. Although the Conservatives have subsequently remained in government, its leadership and priorities have changed significantly together with the concerns and priorities of livestock industry actors. Brexit looks likely to result in both direct divergence from EU rules on antibiotic use and trade agreements that open UK food markets to imports produced under significantly different regulatory conditions (BBC News, 2021). These sorts of agreements would bring UK animal agriculture into new relational formations with global agricultural actors, potentially re-/de-territorialising UK food systems, particularly in instances where UK farming is unable to be competitive with imports. One element of these shifts in the broader animal agriculture assemblage could be the (re)framing of antibiotics as economic/productivity tools necessary for competitive UK farming, deterritorialising the AMR governance assemblage. Or it could further challenge the capacities for 'local' governance of AMR. A situation already complicated by food supply chains passing through countries with very different approaches to antibiotic use including among European Union members (Hughes et al., 2021).

There is also the possibility that more influence is exerted by those actors who are currently constrained in their ability to influence the objects, processes, practices and trajectories of the assemblage. This might include different publics, or organisations such as the Alliance to Save Our Antibiotics, or other NGOs that currently occupy peripheral or at best 'handmaiden' roles to industry initiatives and decisions; publics exerting new political demands on both the way and why of animal agriculture; or animals being positioned as a central object/actor in shaping the AMR governance assemblage. Unable to articulate their own demands, this might take the form of animal health and welfare becoming the object of governance and/or initiatives that engage with animal breeding as a means of governing AMR more holistically. On a hopeful note, this might open up trajectories within which certain agricultural systems are deterritorialised and reassembled on a different relational, practical and material basis with all that this might mean for improving animal lives within systems of animal agriculture. However, these trajectories might evolve in similar ways to past interventions designed to centre animal health and welfare concerns when reassembling production systems. For example, concern for improving housed chicken health (Buller & Roe, 2014) and preventing pneumonia in pigs (Woods, 2019) resulted in the significant intensification of human control over animal bodies, with deeply ambiguous results for the humans and non-human animals in those systems. Similarly, antibiotic stewardship has been shown to have ambiguous implications for animal-human relations within the context of on-farm practices of care (Helliwell et al., 2020).

CONCLUSION

To conclude, we directly address the three objectives outlined in the introduction. First, how have diverse actors worked/are working to assemble AMR governance across animal agriculture. Certainly, new constellations of actors have negotiated and defined new capacities and initiatives to govern AMR. Assembling AMR governance has resulted in new actors, artefacts and practices that have primarily been orientated towards reducing and monitoring antibiotic use on farms. These narrowly defined measures on antibiotic use are situated alongside the broader subjectification of farmers and veterinarians as 'stewards' involved in a programme of antibiotic stewardship that has emerged from the reassembling of a wide range of existing animal health and welfare initiatives through AMR governance. However, simultaneously, these emergent processes have

not troubled the broader assemblage of animal agriculture, its infrastructures, practices and processes of production, care and animal–human relations (Helliwell et al., 2020). Predominantly, industry-aligned actors have been empowered to specify the object of governance, its translation into a technical problem, and the capacities of the assemblage to intervene (or not) in the practices, systems and relations of animal agriculture. The specification of antibiotics as the object of governance has worked to narrow the space for action (Begemann et al., 2020) and re-territorialise existing boundaries, processes, practices and discourses in the regulation of animal agriculture whilst closing down other possibilities. Although reduced, antibiotics are still retained as a crucial technology available to veterinarians and farmers, whereas technical reporting on antibiotic use becomes the central activity through which the assemblage manages AMR governance. However, the subjectification of farmers and veterinarians might open possibilities for local experimentation and initiatives that over time could produce new possibilities for action that are yet to be realised and as such represents one avenue for further research.

Second, the article has addressed the representation and positioning of agricultural animals within the assemblage. The key finding is that animals are largely absent. A prominent degree of rhetorical concern for animal health and welfare does not translate into animals being positioned as central actors/objects for AMR governance. Improving animal health and welfare is not the principal problem of life within which AMR governance seeks to intervene. Instead, antibiotics have become a proxy for agricultural animal health. Low antibiotic use is assumed to be correlated with improved animal health and welfare. These omissions are brought into relief by the ASOA, who foreground possibilities for governing AMR through a more direct focus on animals themselves, notably through breeding agricultural animals that are more resilient to disease. Although this breeding will not necessarily improve the lives of animals within farm systems, it nevertheless highlights one possibility for the governance of AMR to be internalised and enacted through animal bodies and behaviours. This is not to say that animals are entirely absent from the assemblage because, as core constituents of animal agriculture, they shape the capacities of the assemblage. Traces of their influence are found in how animal bodies and agencies create limits to AMR governance. Agricultural animals remain vulnerable to infection both because animal bodies and behaviours are entangled in the farm as assemblage and its production of certain types of vulnerability to infectious disease and because disease is a fact of life. Equally, routine infections are still treated with antibiotics, thus creating limits on the ability of farmers and veterinarians to reduce antibiotics in the context of broader systemic and bodily vulnerabilities and their configuration of infectious disease risks and antibiotic use. Furthermore, the capacity of local practices is limited by the interconnection of UK food systems with broader global supply chains threading together disparate locations, AMR governance and production contexts (Hughes et al., 2021).

Third, to what extent does the assembling of AMR governance constitute a new front in the regulation of agricultural animal lives. This is difficult to assess. On the one hand, AMR governance works to retrench existing relational configurations by specifying antibiotics as the object of governance. Furthermore, the rendering technical of antibiotics obscures the practices and consequences of antibiotic reductions for animals as these are not required to be reported. Agricultural animals fade from view as living bodies as animals exploited for productive purposes and under conditions that prioritise that productivity, as beings with agency within these systems shape elements of them to meet certain needs. However, centring animals within AMR governance does not establish a straightforward trajectory to different systems of production. The Plofkip campaign, identified by the ASOA as an example of how breeding more resilient chickens and extending the timeframe over which they are reared to weight can reduce the need for antibiotic use, was not successful in instigating broader changes to the conditions on intensive chicken farms. However, in

drawing on assemblage theory and biopolitical concepts to examine the assembling of AMR governance and the positioning of animals within this process, we have nevertheless highlighted both the contingency of existing arrangements and opportunities for different actors, objects, knowledges, practices and processes to become involved in realising and doing AMR governance and, by extension, animal agriculture differently.

Both the nature of the data and the way in which AMR governance as practice and discourse obscures agricultural animals in favour of centring antibiotic chemicals as the object of governance means it has not been possible to examine in detail the implications of this governance process for the lives of agricultural animals. This both highlights the need for future research examining on-farm more-than-human relations that build towards delineating the ways in which animal behaviours, bodies and lives are being shaped by and shape AMR governance (see Hinchliffe et al., 2017; Lorimer et al., 2019 for methodological examples). However, AMR and its governance are part of a broader agricultural assemblage that shapes the disease and AMR pathologies that are generated and how they can be governed. This points to the need for research that contributes to the broader task of re-examining animal agriculture in terms of its emergent trajectories of intensification and industrialisation in particular the development of so-called ‘mega’ farms (Wasley et al., 2017) and their social legitimacy. Furthermore, it suggests that there is a need for a broader debate on what kind of agriculture we want in the future and how the re-territorialisation of animal agriculture towards new trajectories, for example, moving beyond animal-based food systems (see Morris et al., 2021), might be realised.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data are available on reasonable request.

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ENDNOTE

¹We note also in this context that publics as consumers rather than citizens also feature within the membership of RUMA that ‘spans the livestock industry and includes organisations representing interests in agriculture, veterinary practice, the pharmaceutical industry, retail, *consumers* and animal welfare interests’ (RUMA Alliance, 2014, p. 7).

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