

Antibiotic policies in the UK dairy industry:  
A voluntary industry-led approach  
in action

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*By*

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This thesis is based on research carried out in the Department of Epidemiology and Population Health, Institute of Infection and Global Health, University of Liverpool.  
Except for where indicated, this thesis is my own unaided work.

Stephanie Begemann  
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## Abstract

### **Antibiotic policies in the UK dairy industry: A voluntary industry-led approach in action.**

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Today a major topic of concern is the use of antibiotics in food animals and its link with the development of antimicrobial resistance (AMR) in humans. Public health agencies across the globe frame the ‘misuse and overuse’ of antibiotics in agriculture as major human driver to the development of AMR in animals, humans and the environment. In 2016, the United Kingdom (UK) has made its livestock sectors and food supply chains responsible to reduce and achieve responsible antibiotic use. Since, antibiotic surveillance systems are being implemented across livestock sectors to measure and monitor antibiotic practices. This is complemented with educational interventions and guidelines to ‘rationalise’ antibiotic use by farmers and veterinarians. According to the latest UK veterinary antibiotic surveillance and sales report, the sales of veterinary antibiotics for use in food-producing animals have dropped with 40% between 2013 in 2017. It is believed by governmental and agricultural policymakers that the antibiotic policies undertaken by the livestock sectors is taking force.

This PhD thesis has reconsidered the progress claimed by the UK veterinary antibiotic surveillance and sales reports. Moving beyond statistical realities, it examined how the UK’s industry-led approach is taking shape in practice. A multi-sited ethnographic methodological framework has been used to examine at first how the UK has consolidated around an industry-led approach, in contrast to some other European countries who used legislation to tackle persistent antibiotic practices. Second, taking the UK dairy industry as case study, interview and observational methods were used to understand how dairy policies are formulated by the dairy sector and dairy supply chains and how the policies are practised by farmers and veterinarians. Findings reveal that the policies in the dairy industry only partially address the complex network of people, animals and the environment in which dairy antibiotics circulate. Although milk processors and retailers in the UK have taken up the lead to produce dairy antibiotic policies, the policies seem to benefit market purposes rather than addressing structural issues in UK dairy production systems. Some of the antibiotic policies produce new travel routes of antibiotics between systems resulting in new public health risks. Other antibiotic policies fail to assess how veterinarians and farmers are constrained in their antibiotic choices by their agricultural actor-networks. As a result, the UK’s industry-led approach maintains and reproduces irresponsible antibiotic practices in the UK dairy industry.

This study reveals how antibiotic ‘misuse and overuse’ in agriculture is far from a behavioural matter, with solely farmers and veterinarians to blame. Instead, antibiotic use in food animals is embedded in complex economic networks that constrain radical changes in dairy husbandry management and antibiotic use on farms. To achieve responsible farming and improve antibiotic practices, the UK government should take responsibility and work more closely with the UK livestock sectors to understand what regulatory and financial support is needed.

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## List of abbreviations

Antibacterial Growth Promotor - AGP

Antibiotic(s)- AB(s)

Antimicrobial Resistance - AMR

British Veterinary Association -BVA

British Veterinary Cattle Association - BVCA

Department for Environment, Food and Agriculture - DEFRA

European Centre for Disease Control - ECDC

European Commission - EC

European Food Safety Authority - EFSA

European Medicine Agency - EMA

Food Standard Agency - FSA

Ministry of Agriculture, Fisheries and Food - MAFF

National Milk Records - NMR

National Office of Animal Health - NOAH

National Farmers Union - NFU

Responsible Use Of Medicines in Agriculture Alliance - RUMA

Science and Technology Studies - STS

United Kingdom - UK

Veterinary Medicine Directorate - VMD

World Health Organisation - WHO

# **Chapter 1**

## Introduction

## 1.1 Introduction

Antimicrobial Resistance (AMR) is the ability of a microbe (such as bacteria, fungi, viruses, and parasites) to resist the effects of medication (such as antibiotics, antifungals, antivirals, antimalarials, and anthelmintics) that once could successfully treat the microbe. The use of antibiotics (ABs) in livestock is believed to contribute to the development of antibacterial resistance in humans (World Health Organisation, 2001). From 2011 onwards, global awareness and a call for action by the World Health Organisation (WHO) has placed the problem of AB ‘misuse and overuse’ in human and animal settings high on political agendas (WHO, 2011b). Countries are being urged to implement and/or improve national strategies in order to reduce livestock AB-use. In 2016 in the United Kingdom (UK), after deliberation between experts, governmental and agricultural policymakers, a voluntary industry-led approach was established. The UK livestock sectors were made responsible for designing AB policies and to control AB practices. However, previous experiences of voluntary industry-led approaches in the UK have shown a lack of livestock industry commitment and consequently, little success in AB reduction across its livestock industries (UK-VARSS, 2013). Other European countries who made significant progress in reducing AB-use together with improving their herd health practices have all used official regulation with their governments closely monitoring progress (Cogliani et al. 2014) . What made the UK government agree to continue with a voluntary industry-led approach? What was at stake in transferring the governance of livestock AB-use to the UK livestock sectors? Following from this, how is a voluntary industry-led approach actually done in practice?

This thesis will consider these gaps in knowledge about the UK’s industry-led governance model of livestock AB-use. Using Science and Technology Studies (STS) as a theoretical and methodological framework, livestock ABs are the central objects of study. Of key interest is to examine how livestock ABs are constructed as a concern within and across political and agricultural arenas, and how this influences their political and local governance. The first part of the thesis will examine how scientific evidence was used over time by UK policymakers, experts and the agricultural industry to frame livestock AB-use as a public health risk. By examining what was at stake during the problematisation of livestock AB-use as public health risk, insights will be provided into how the UK’s political culture co-produced its governance of responsible livestock AB-use. The second part of this thesis will focus on how the UK dairy sector implemented dairy AB policies from 2016 onwards, as this sector still heavily relies on standard AB treatments. AB decision-making in relation to risks and responsibilities will be studied from within dairy agricultural knowledge networks. This will provide further knowledge on the effects of an industry-led policy model on livestock AB-use in practice.

In what follows in this introduction, I will discuss how AB-use in the food animal industry is internationally framed as a public health risk. I will introduce the UK's industry-led approach, which trusts the food animal industry and their 'methods of science'<sup>1</sup>, such as AB surveillance models and educational tools that have been introduced to 'rationalise' farmer and veterinary AB practices. This will be opposed to the public-private policy model of Sweden, Denmark and the Netherlands, which uses legislation to tackle structural commercial interests attached to veterinary prescribing. The limitations of AB surveillance models and educational tools that underpin the UK's industry-led approach will also be discussed. Moving away from human behaviour as the central object of study, I will introduce the theoretical framework of Science and Technology studies (STS). I will explain how I will turn my research gaze towards livestock ABs themselves as central object of study, and what STS concepts and theories I will use to trace livestock ABs across sites where they have come to matter.

## 1.2 Relevance of the 'problem'

### 1.2.1 Antibiotics as valuable agents across human and veterinary medicine

ABs are produced in nature by bacteria or fungi as a chemical defence mechanism, to protect themselves from other micro-organisms in their neighbouring environments (Walsh, 2000). This dates back hundreds of millions of years, which means AB resistant bacteria is not a modern occurrence but an ancient, natural phenomena (D'Costa et al., 2011). ABs are often referred to as 'magic bullets', as they kill disease causing microbes without harming the host (Chandler & Hutchison, 2016, p. 3). Since their discovery in the late 1920's, the use of ABs has revolutionised health care by controlling micro-organisms that pose risks to health; reducing associated morbidity and mortality rates across human and animal populations (O'Neill, 2014). More than 85% of human infections worldwide results from acute respiratory infections, diarrhea, measles, AIDS, malaria and tuberculosis (WHO, 2001). ABs are vital medicines to reduce mortality rates of these diseases when bacterial infections follow. They are also essential medicines in hospitals to prevent infections during surgical interventions, cancer chemotherapy and organ transplantation (Davies, 2011).

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<sup>1</sup> I refer to 'methods of science' in this thesis as methods grounded in the experimental method and on observations of the natural world (Green & Thorogood, 2004). Methods of science are considered by political and scientific communities as methods able to produce knowledge independent from the social world, and therefore able to generate objective, rational and neutral data (Green & Thorogood, 2004). Examples are surveillance, systematic risk assessments, scientific measurement and economic calculation, used to establish relationships of cause and effect and manage technological risks (Barry, 2002; Jasanoff, 2016; Leach & Dry, 2010).

Since the 1950s, ABs have also become routinely used in global food production systems, by contributing to food security, food safety, animal welfare and animal and crop production (WHO, FAO, & OIE, 2016). ABs can be used to prevent or treat bacterial infections in individual or groups of animals. There are four types of AB usage in agriculture (Callens, 2015): 1. Strategic prophylaxis or preventative treatment, in group or individual animals, before clinical signs of disease are apparent to avoid infection. Some examples include surgery, transport and mixing of animals, intra-mammary treatment at the end of lactation in dairy cattle. 2. Metaphylaxis or control treatment, which is the treatment of a group of animals after the development of clinical signs of disease. This type of treatment treats both clinically affected animals, while controlling transmission to other animals of the group. 3. Curative or therapeutic treatment, in individual animals that show clinical signs of infection. 4. Antibacterial Growth Promotor (AGP) use in food producing animals (Callens, 2015). This prolonged subtherapeutic use of antimicrobials was discovered in the early 1950s, when it was identified that ABs fed in low doses to food-producing animals improved growth, food conversion ratio and reproductive performance (Reijnders, 2006) . Consequently, AGPs became used globally as economic tools in several industrialised animal husbandry production systems. In 2006, the European Union was the first organisation to ban the use of AGPs following scientific and public concerns about their association with AMR in humans (Begemann et al. 2018). The United States only banned antibiotics used for enhancing growth in livestock on January 1, 2017 (Kahn, 2016). To date, most regulatory agencies are currently focused on the control of antimicrobials used for non-therapeutic use in livestock. However, some antimicrobials are still registered for prophylactic and metaphylactic administration in livestock, posing a challenge for policymakers (Brown et al. 2017).

Veterinary antibacterials can be administered to food producing animals through various routes (Callens, 2015). Local or topical use involves cutaneous (skin) treatment, nasal, intra-articular, intra-ocular, intra-auricular, and intra-mammary and intra-uterine. Systemic use is the administration via oral (medicated feed or water) or parental routes (intravenous, intramuscular, intraperitoneal, transdermal and subcutaneous injections) (Callens, 2015). These different routes of administration, together with a large variety of types of veterinary ABs, has led to a wide range of veterinary AB products available on pharmaceutical markets. Similarly, food animal feed companies that are licensed can incorporate ABs into the feed they sell, adding commercial benefits to the sale of medicated feed (Kahn, 2016).

In the UK, around 30% of ABs are believed to be used in veterinary medicine, of which 87% are in the livestock sector (Buller et al., 2015). ABs in the UK are classified as ‘POM-V or Prescription Only Medicines – Veterinary Surgeon’, which means they can be used on veterinary prescription basis only (UK-VARSS, 2018). However, once prescribed, farmers are

able to store ABs on farms and administer ABs without veterinary supervision. In other countries in Europe, such as Sweden, Denmark and the Netherlands, farmers are not allowed to routinely administer ABs themselves (EMA, 2018) ABs are used in the UK livestock sector to combat and prevent animals disease, while maintaining the health of herds and flocks. As such, a wide range of properties and interests attached to these medicines have made ABs move across hands and sites, in which they have become indispensable (Reynolds Whyte et al., 2003). Veterinary ABs have not only become essential as therapeutic tools, but have become part of economic ‘infrastructures’ across global health and food production systems and commercial markets (Chandler et al. 2016).

### 1.2.2 The burden and consequences of AMR

The downside of the popularity of ABs is the rapid development of bacterial resistance (WHO, 2011a). Antibiotic resistance occurs once micro-organisms cease to be killed or inhibited in the presence of cytotoxic concentrations of ABs (Wright, 2007). Antimicrobial resistance is a broader term, encompassing resistance to drugs for treating infections caused by other microbes, such as parasites, viruses and fungi in addition to bacteria (WHO, 2015)<sup>2</sup>. Although antibiotic resistance is considered a natural phenomenon, human and animal AB actions, such as poor infection prevention, poor control practices and excessive use of antimicrobials in human and animal medicine, are believed to increase the selective pressure in favour of resistant micro-organisms to survive, while killing the sensitive organisms (WHO, 2015). As Walsh (2000, p. 776) has argued, ‘once an AB is proven to be effective and enters widespread human therapeutic use, its days are numbered’.

Problematically, a variety of use of AB types overlap in both human and veterinary medicine. When antibiotic resistance occurs in bacteria after AB-use in animals, resistant bacteria have the potential to spread from animals to humans (Economou & Gousia, 2015; Van Den Bogaard & Stobberingh, 2000). Zoonotic micro-organisms (or mobile genetic elements) from animals and humans can travel in both directions; from human contact with animals (farm, wildlife or companion), through the food chain, and through contact with waste from humans, animals and pharmaceutical plants (Public Health England, 2014). Resistant genes restrict themselves not only to human and animal hosts, but persist in manure and slurries, which enter agricultural lands and become integrated with soil microbes (Kahn, 2016). Wildlife, especially birds, contribute to the spread and transmission of resistant genes (Public Health England, 2014).

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<sup>2</sup> This thesis focuses on antibiotics as antimicrobial agents and resistance in bacteria to antibiotics. As antibiotics are antimicrobials, antibiotic resistance and AMR will be used interchangeably throughout this thesis.

Equally, worldwide human travel and livestock transport is also believed to contribute significantly to the rising threat of AMR (Van der Bij & Pitout, 2012).

The ecological complexity of AMR continues to produce uncertainties about the precise factors that lead to selection and maintenance of resistant organisms in bacterial populations (Economou & Gousia, 2015). The use of ABs in livestock is believed to contribute to the development of AMR, but there are ongoing controversies regarding the level of risk to human health. The invisible routes of AMR transmission make it difficult for scientists to assess how AB-use in food animals contributes to AMR in human pathogens (Landers et al., 2014). Nevertheless, bacteria found in humans, animals and food continue to show resistance to antimicrobials used across species (ECDC, EFSA, & EMA, 2015). In addition to the scientific uncertainties, it is estimated that the human cost of AMR currently claims at least 50,000 deaths each year across Europe and the US alone, and could go up to 10 million deaths in 2050 (O'Neill, 2014). Moreover, economic experts (O'Neill, 2014) argue that the increased mortality and morbidity as a result of AMR will impact on global economic productivity. If developing resistance continues at the same rate, the world will be producing between 2% to 3.5% less in Gross Domestic Product (GDP), costing the world 100 trillion USD by 2050 (O'Neill, 2014).

### 1.2.3 The global problematisation of antibiotic use in agriculture

In response to the uncertainties involved with livestock AB-use, the 'overuse and misuse' of antimicrobial agents in humans and animals was framed by the WHO in 1998 as the main cause for the increased emergence and spread of micro-organisms (WHO, 1998, p. 3). Subsequently, AB 'overuse and misuse' reappeared across international and national reports as one of the main human drivers for AMR. In 2001, the WHO urged countries to develop national action plans, which should include the creation of national surveillance systems to monitor antimicrobial usage in food animals and AMR, to implement veterinary prescribing guidelines and to design education-based programmes for veterinary surgeons to reduce the 'overuse and misuse' of antimicrobials in food animals (WHO, 2001, p. 37). In September 2009, the European Medicines Agency (EMA) launched, 'The European Surveillance of Veterinary Antimicrobial Consumption' project (ESVAC) to capture trends in farmer and veterinary use. This project coordinates the collecting and reporting of sales of veterinary antimicrobial agents in animals from member states (EMA, 2011). The report from the European Commission in 2011 on AMR discussed how the 'inappropriate' use of therapeutic antimicrobials across human and veterinary medicine, the use of antimicrobials for non-therapeutic purposes and contamination of the environment 'jeopardized' AB applications (European Commission, 2011, p. 2). Equally, the most recent WHO (2015) global action plan



frames the ‘misuse and overuse’ of livestock and human AB-use as a key driver of the acceleration of AMR.

Leach and Dry (2010, p. 27) have revealed the discursive power of global language to problematise epidemics and subsequently summon into existence an ‘imaginary’ consensus how to govern them. AB ‘misuse and overuse’ across human and agricultural settings is widely accepted today as the main human driver that could potentially accelerate AMR in organisms and the environment (WHO, 2015). With nations collectively agreeing on this risk narrative, it is made governable, nationally and globally (Leach & Dry, 2010). This is supposed to foster a coordinated approach to face the chaotic and disorganised landscape of AMR by prioritising policies that tackle livestock AB ‘overuse and misuse’. Countries are however given flexibility within this framework, to determine what they consider as a concern in their national AMR action plan. Furthermore, the European Centre for Disease Prevention and Control (ECDC), the European Food Safety Authority (EFSA) and the European Medicines Agency (EMA) stated in 2015, that a positive association was found between antimicrobial consumption in food-producing animals and occurrence of resistance in bacteria from such animals (ECDC et al., 2015). They recommended refining existing surveillance systems by providing detailed information on antimicrobial consumption in species and production types in animals, continue the monitoring of AMR, and promote responsible AB-use of antimicrobials in animals. Consequently, the reduction of sales of veterinary antimicrobials has become a desirable objective in the combat against AMR (EMA, 2018, p. 15).

#### 1.2.4 Different European responses to regulate antibiotic use in agriculture

##### **The UK’s industry-led governance model**

The ‘UK Antimicrobial Resistance Strategy and Action Plan’ of 2000 and the ‘UK 5 Year Antimicrobial Resistance Strategy (AMR) 2013-2018’ highlighted the need to reduce ‘unnecessary and inappropriate’ use of ABs in food producing animals. In these AMR action plans, the UK livestock sector was given the responsibility to improve its AB usage surveillance systems and to implement education, training and guidelines to optimise AB-use and animal husbandry by farmers and vets. However, concerns across the media and various pressure groups (Soil Association, British Society for Antimicrobials, Alliance to Save Our Antibiotics) blamed the intensive livestock sector for the excessive use of ABs in food animals, increasing the risk of antimicrobial resistance (Morris et al., 2016). In 2014, the ‘Review on Antimicrobial Resistance’, an economic expert committee chaired by economist Lord Jim O’Neill was commissioned by the then Prime Minister, David Cameron, to take the lead on

AMR as a global problem (O'Neill, 2014). In 2015, the Review provided an overview of the public health and economic health risks involved with the use of ABs in animals and agriculture (O'Neill, 2015). Criticising the 'excessive' use of antimicrobials in agriculture, by arguing 70% of antimicrobial use in the USA is used in animals (O'Neill, 2015, p. 6), the review provided in their final report of 2016 three global recommendations. First that all nations should produce 10-year targets to reduce AB-use, which were introduced in 2018. Second, the use of Highest Priority Critically Important Antibiotics (HP-CIAs) for human health needed to be banned or restricted. Finally, AB surveillance systems needed to be improved, with food producers in charge to provide transparency on AB-use in their food supply chains. As will be discussed extensively in Chapter 4 of this thesis, the framing of the O'Neill expert reports resulted in a controversial debate, in which the livestock sectors initially disagreed with the recommendations.

Responding to previous concerns, the UK government incorporated the main recommendations of the O'Neill Review in their 'Government Response to the Review on Antimicrobial Resistance' policy report of 2016 (Department of Health, 2016). A regulatory compromise between governmental and industry policymakers was made: the livestock industry would implement most of O'Neill's recommendations. If successful, no regulatory intervention would be necessary. A multispecies reduction target to 50 mg/kg by 2018 was set from 62 mg/kg in 2014 (Department of Health, 2016). Aside from this target, species experts of the livestock sectors had to produce sector-specific HP-CIA and overall AB reduction targets by 2018, underpinned by herd health activities to improve animal husbandry (Department of Health, 2016). Furthermore, individual livestock sectors and their food supply chains were responsible for setting up AB usage monitoring systems, raising AMR awareness amongst farmers and vets, improving veterinary disease prevention and prescribing practices and improving farm management and animal welfare, to reduce the need for AB treatments. Importantly, within these policies, the vet-farmer relationship is positioned as fulcrum to drive change (RUMA, 2017). Supported by industry-led training, protocols and guidelines, vets and farmers are stimulated to work together upon the policies in partnerships, rather than in expert-lay relationships. This is considered to foster collaboration and share power between both professions. Evaluating other approaches in European countries, different risks have been prioritised.

### **Public-private led governance models**

Sweden, Denmark and the Netherlands, often position themselves as 'example countries', are governed through public-private models, which means they have both legislative and industry-

led initiatives in place (Aarestrup, 2015; Lundström, 2016; Speksnijder et al., 2014). Each country (Lundström, 2016; SEGES, 2014; Van Beers-Schreurs, 2016) implemented the following policies: AB reduction targets, veterinary prescribing guidelines, mandatory Herd Health and Herd Treatment plans, and restrictions or bans of HP-CIAs. To make all antimicrobial usage on farms and by vets transparent, national AB surveillance systems have been established that are governed either by the government (Denmark), by an independent authority (the Netherlands), or by both the government and industry (Sweden). Denmark and the Netherlands use these data to ‘benchmark’ farmers and vets to identify high users/prescribers. Veterinary prescribing is strictly therapeutic only; restricting the prophylactic and metaphylactic use of ABs at herd/flock level, unless evidence suggests differently. In-feed ABs can only be used for therapeutic purposes, tackling some of the economic interests involved with feed companies (Lundström, 2016; SEGES, 2014; Van Beers-Schreurs, 2016).

Each strategy of these countries contains boundaries to tackle economic veterinary prescribing pressures. Sweden (Lundström, 2016) and Denmark (Aarestrup et al., 2010) ‘decoupled’ the prescription of ABs from sales of veterinary medicines by vets. This means vets in these countries are not permitted to own a pharmacy or sell medicines for profit, resulting in no economic incentive for vets to prescribe ABs to farmers. ABs are dispensed to farmers through pharmacies, supplied by drug wholesalers or manufacturers (Wierup 2001). In the Netherlands, decoupling was considered by the government and the options were examined by an independent consultancy bureau (Berenschot, 2010). The resulting report stressed that decoupling would not be effective and recommended instead to strengthen the position of vets as gatekeepers. Consequently, the Dutch government implemented an intervention in 2014 (UDD maatregel), which allows for only vets to prescribe and administer ABs (Speksnijder et al., 2014). The vets may only prescribe after clinical inspection on the farm and diagnosing an issue that requires treatment. There are however exceptions in which farmers can keep small amounts of ABs on the farm under strict control of the vet. To further strengthen the consultancy role of the vets, the countries have implemented mandatory 1-to-1 contracts between farmers and vets. This requires each individual farmer to have an appointed vet, with whom he/she evaluates, on a regular basis, mandatory herd health plans and disease protocols (Speksnijder et al., 2014). Farmers are as such not able ‘to shop around’ for vets who can sell them drugs; they are dependent on the clinical gaze of their contracted vet.

## Trust versus legislation

The legislative initiatives of the public-private governance models pushed vets in these countries to transition from drug-financed business models to consultancy-financed models. At the same time, they facilitated for the livestock sectors to focus on prevention strategies, to invest in animal husbandry knowledge, and consequently to lower the *need* for ABs. In contrast, UK's industry-led approach is built on trust, in that the livestock sector and their instruments, such as the AB surveillance systems and evidence-based communication tools, are able to drive change in the mindset of farmers and vets, and to produce objective inscriptions of that change.

In 2015, Buller, Hinchliffe, Hockenhull, Barrett, & Reyher (2015), by request of the UK Department of Environment, Food & Rural Affairs (DEFRA) examined how ABs are used in farms and how the notion of AMR influences these practices. They found a tendency amongst farmers and vets to underplay the importance of the livestock sectors' contribution to AMR as a public health issue. They identified five areas of concern: 1. Prophylactic and metaphylactic use might still be in place for inappropriate purposes 2. Inappropriate use of ABs to treat animal health issues 3. Unnecessary use of later generation ABs also used in human medicine, when other older ones would be as effective 4. Over-dependence on ABs as a replacement for improved animal husbandry 5. Incorrect dosage and application on-farm. Furthermore, what becomes clear from this study is that there are still commercial realities at play that drive non-therapeutic AB practices (Buller et al., 2015).

The previous discussion raises some questions: How is the UK's industry-led approach tackling the previous areas of concern? Can we trust scientific methods, controlled by the livestock industry, to tackle commercial interests and to rationalise use?

## 1.3 Rationale for this study

### 1.3.1 Interrogating technocratic interventions

AB data surveillance and AB knowledge tools are believed to promote the production of 'certified knowledge' (Sismondo, 2010, p. 8). According to the UK's industry-led policy models, these evidence-based/technocratic interventions know best how to use AB medicines and how to convert farmers and vets to correct ways of thinking about how to use them. This positivistic thinking differentiates between what is considered as science and what is considered as culture: human values interfere with the objectivity of natural facts and facts need to be purified of values to become objective knowledge. People are seen to behave rationally once they understand their contextual constraints and motivations (Green &

Thorogood, 2004). To positivists, scientific methods are seen as the gold standard to approach phenomena; it unifies methods, provides a solid connection between observations and data, and agrees what evidence represents the truth about the natural world (Porter, 1995, p. 20; Sismondo, 2010, p. 4). The positivistic model and its truth claimed by scientific methods have however come under increasing scrutiny, as several social scientists have argued that science, its methods and its technologies are grounded in social activities, rather than objective and value free (Jasanoff, 2004; Sismondo, 2010). Equally, AB surveillance systems and educational tools are not artefacts that stand outside the realm of contexts. As will be discussed next, they are co-constructed by the needs, interests and practices of these particular contexts.

### 1.3.2 Surveillance models and their metrological fragility

AB data surveillance models are used to produce objective numerical data about AB behaviour to identify the success of interventions. Leach and Dry (2010) argue how surveillance models have become important tools used to assess and evaluate global risks. Global surveillance networks are seen as the new solution to failure of national health systems. Their numerical ‘facts’ have the power to order problems, settle uncertainties, and govern the social (Mansnerus, 2013). However, Leach and Dry (2010) reject the objectivity of scientific data models and discuss how these scientific models have social and political lives. They observe a close interplay between science and politics that influence the processes of modelling. The politicisation of a problem, why it matters and to whom and what should be done about it co-constructs the development and preservation of these models (Leach and Dry 2010). This becomes clear when we evaluate how nations approach AB surveillance models, their implementation and governance differently. Moreover, as will be discussed in Chapter 4 and 5, differences exist between and within UK livestock sector groups in how they design and implement AB surveillance models.

At the same time, Barry (2002, p. 270) argues how the authority of numerical evidence suppresses ‘potential places for contestation’, enabling debates to settle. Models and calculation become more than information; they serve as ‘anti-political’ instruments to steer debates and settle concerns (Maesele, Hendrickx, Pavone, & Van Hoyweghen, 2013, p. 208). Equally, Jasanoff (2016, p. 53) argues how ‘assigning number to a scenario is itself a means of framing and therefore is also a political act’. Consequently, some elements of an issue at stake are difficult to calculate and escape the metrological gaze: ‘calculative realities’ are ‘thin’ descriptions of reality (Jasanoff 2016, p.58). This has also been discussed by Barry (2002), who speaks of the ‘fragility of metrological regimes’ (p.274). Standardised procedures of models are not able to represent the complexity of the object and its practices in action (Barry

2002, p.275). Moreover, data can easily misrepresent an object under investigation, as the situation is framed, leaving out a whole series of other questions.

Using veterinary AB sales data, global and national claims upon progress in livestock AB-use are made (EFSA, 2017). Evaluating 2016 veterinary AB sales data in the UK (UK-VARSS, 2017), the UK livestock sector already achieved the national cross sector target of 50 mg/PCU. However, veterinary AB sales data from pharmaceutical companies tells us nothing about how ABs end up being prescribed, dispensed and administered. Then how do data presented through AB surveillance systems upon AB sales/usage actually reflect AB practice? Are the areas of concern in which ABs are used irresponsibly improving? What happens outside the statistical realities of livestock AB-use?

### 1.3.3 The limitations of education-based interventions

One of the pillars of the UK's industry-led approach are education-based tools and programmes, which are believed to be capable of rationalising behaviour. These evidence-based tools and programmes need to standardise the industry's mantra; 'right drug, right dose, at the right time' (RUMA, 2017). Protocols, guidelines and standards became popular tools during the 1960s-1970s, as they were seen as tools that could unify medical practices and guarantee similar approaches to evidence across medical institutions (Berg, 1998, p. 227). These tools pressure 'uniformity and reproducibility' by providing a set of instructions, which help people in charge to structure their decision-making process (Berg, 1998, p. 228). Guidelines and protocols are often produced with the intention to organise decision-making capacities of individuals. By addressing the 'limitations and failures' of individual thoughts, they serve as a recipe to structure individual thoughts into a standardized, collective assemble (Berg, 1997, p. 1083). By 'advising' individuals to take sequential step by step actions however, the protocol ignores contextual factors at play that drive processes of individual and collective action, and how in turn, these contexts shape protocols (Berg, 1998).

Enticott (2012) has explored the relationship between veterinary practices and protocols. Focusing on how vets adopt bovine tuberculosis (bTB) protocols in England and Wales, he shows how the 'smooth', rigid protocol becomes 'replaced and transformed' by 'informal and situated' practice (Enticott, 2012, p. 76). Veterinary expertise is not a stable, nor a mechanical response to disease encounters. Instead, veterinary expertise is co-produced by the circumstances of the on-farm encounter and the geography of animal disease. A 'clash' can therefore often be observed between the 'evidence-based' theory of protocols/guidelines/standards and the reality of the professional decision making processes (Berg, 1997, p. 1083). Unexpected clinical conditions, time pressure, environmental constraints,

insufficient professional skills, and limitations of technologies can all interfere with how protocols will get adopted in clinical situations. Knowledge exchange tools are not inert, flawless representations of how the practice shall become; they are fluid tools that reshape practices in co-production with existing socio-material realities at play (Berg, 1998). Berg (1998) argues that as such, more understanding is needed on how different logics on phenomena co-exist and how they have come into play in practical realities.

Hamilton (2017) is equally critical of evidence-based approaches that aim to bridge the theory-practice divide during the vet-farmer encounter. Many evidence-based approaches that circulate to bridge the theory-practice divide try to impose theoretical knowledge upon clinical situations to achieve change. As Hamilton argues (2017, p. 225), ‘knowledge is not a ‘product’ requiring discovery, communication and uptake’. Instead, during the vet-farmer encounter, knowledge gets tweaked and tinkered with, to serve its purpose. The exchange of knowledge should be considered as a process rather than an exchange of an ‘artifact’ (Hamilton, 2017, p. 5). Taking the former discussion into account, science and its methods are not transferred through a linear process in practice. How can we evaluate whether the reduction targets, educational and awareness programmes deliver what they promise, e.g. driving the mindsets of farmers and vets? What about the economic and commercial concerns across food supply chain, producer and veterinary landscapes?

## 1.4 From science to practice

### 1.4.1 Turning towards the object: antibiotics

In this thesis, it will be argued that there are limitations attached in trusting scientific methods and their evidence to govern AB-use in agriculture. Surveillance models only partially represent reality and the adoption of knowledge tools is not a straightforward process. There is as such, a gap in knowledge in the design and workings of the UK’s industry-led policy approach in practice. To address the former interest, I will examine how livestock AB-use is framed, managed and communicated across UK political and agricultural settings. Instead of accepting established risk frames, regulatory responsibilities, and granting scientific methods analytical privilege, I want to examine how the risks of livestock ABs are framed at a number of locations: parliamentary politics, livestock sectors, food supply chains, producers and vets. Where other studies separate previous locations as sites of research, I want to explore how these sites interfere and co-exist with each other, and how this shapes AB governance and its practices (rather than the instruments of sciences). To do so, I will turn my gaze away from wanting to capture human behaviour and turn it towards the action of the object itself: livestock ABs.

This reasoning is situated within the broader framework of Science and Technology Studies, which underpins the theoretical framework of this thesis. STS developed during the 1970s as a reaction to the ‘objective’ status of the natural sciences, arguing that the natural sciences are inherently social (Sismondo, 2010, p. 10). Building on previous scholarship that rejected the deterministic claims of natural sciences (Kuhn, 1962; Polanyi, 1962; Popper, 1963), STS scholars argue that it is by studying the social practices of science that we can understand how they are mutually constituted by other institutions in society, such as law and political systems (Bijker et al., 2010; Jasanoff 2005 a; Sismondo 2010). Taking scientific objects or technologies as objects of study rather than human behaviour, STS scholars study the formulation of knowledge practices within and across sites of interests, in which the object circulates. Instead of separating what is considered as science and what is considered as culture, STS bridges the nature/culture divide, by bringing non-human actors into their analytical framework. Animals, technologies, literature, microbes, chemicals, institutions, laws, markets, and many more shape how humans order life. The relations we build with human and non-human actors, which Latour (2005) refers to as Actor Networks in his Actor Network Theory (ANT), shape how we produce knowledge, and how this knowledge in turn, shapes the configuration of the actor-networks (Sismondo, 2010).

How knowledge is produced upon ABs depends what concerns (in terms of other actors) are attached to the ABs. For a farmer, ABs represents healthy cows and economic security, and as such, dependency. For vets, ABs deliver farmer customers and financial income. For a retailer, ABs pose a risk to consumer trust and unstable markets. For policymakers, ABs used in livestock are suspected to pose a threat to public health. For experts, ABs provide publications and professional recognition. As will be explained throughout the thesis, different matters of concern circulate about ABs, depending upon the network they belong to. The way in which ABs matter across actor networks, and how this results in different priorities and responsible AB-use practices is of particular interest to this thesis. Certain human and non-human actors might facilitate or constrain policy formulation, implementation and practice. Exposing these actors therefore, will provide more insights in to how the UK’s governance model works in practice. Including non-humans in my research is of importance, as it allows me to explore what actors come to define AB policies and practices.

Taking the former discussion into account, my interest goes beyond the philosophies of social constructivists, who argue reality is merely an expression of human epistemology (how we come to know the world). Instead, I take a realist constructivistic approach to study how actor-networks continuously ‘assemble and re-assemble’ ontological realities (what the world is made of), in accordance with what is at stake in *their* actor-networks (Latour, 2005). Due to the existence of multiple actor-networks in which livestock ABs circulate (politics, science,



agriculture, food supply chains, consumers), there are multiple AB actor-networks that co-exist and shape each others' networks. The co-existence of multiple ontological object worlds has been explored by Law and Mol (2011) in their research towards understanding how vets diagnose and work with Foot and Mouth Disease. The authors find differences in how veterinary epidemiologists, clinicians and the laboratory operate: they have different interactions with the disease and they *do* different practices of investigation. Instead of looking with a different perspective to the same world, Law and Mol (2011) show how each specialist/tradition works with their own specific ontological variant of the disease.

This PhD project will examine which ontological variants of livestock ABs circulate in the UK. As previously discussed, I am interested to understand how nations govern and practice livestock AB-use differently, and how we can assess the impact of these policy frameworks. More specifically, I want to understand how governmental and agricultural policymakers in the UK define responsible AB-use, and how this ontological variant is performed in practice. How do AB actor-networks out there respond to the UK policy framework and what are the intended and unintended effects? I will next introduce the concept of 'political cultures', which I will use in chapter 3 and 4 to examine how UK policymakers problematised/politicised livestock antibiotic use as risk and what mechanism in the UK were used to settle/de-politicise the issue. Afterwards, I will bring in the concept of 'co-production' and elaborate on ANT to explain how I will study in chapter 6 and 7 the adoption of AB policies by the UK dairy industry.

#### 1.4.2 Science and politics: what counts as 'evidence'?

The first part of this thesis explores the politics of governance itself: why did the UK decide to implement an industry-led approach, even though there is an awareness of commercial realities attached to livestock AB? What was the *process* of decision-making, e.g. how was evidence on livestock AB-use as a public health risk produced, negotiated, framed? Examining how an issue becomes problematised, how consensus is achieved and by whom, will provide an insight in how boundaries are set, how responsibilities are distributed and what institutional reasoning underpins the former (Jasanoff, 2005a). This is of importance, as it will bring me towards an understanding of whose views have come to dominate at the expense of others and which views control the governance of livestock AB-use in the UK. Moreover, it will enable me to situate this thesis in the broader debate of AMR governance; how should we evaluate the performance of different nations with respect to governing livestock AB governance? I will return to the latter question in the discussion of this thesis.

To examine the origins and persistence of the UK's industry-led approach over the decades, I will use STS scholar Sheila Jasanoff's (2005a) theoretical concept of 'political cultures'. Questioning the universality of science and its methods, Jasanoff argues that science, just as other types of knowledge, is situated in human interests. Political cultures, then, represent the way in which nations choose to govern uncertainties that accompany bio-objects and their innovation. Events that present themselves in society do not in themselves define public response and political action. Events enter in interpretative contexts, and will become framed in accordance with how contexts make sense of the event, rather than it being an objective encounter (Jasanoff, 2005a). Consequently, when uncertainties about bio-objects, such as medicines or biomedical technologies, define themselves in society, countries have specific ways of interpreting, framing and managing biotechnological risks. Values about acceptable levels of risks, cost-benefits or public priorities can become reflected in a country's selective use of scientific knowledge, prioritising certain knowledges over others. There are assumptions involved in what it is expected that science should deliver, however sometimes tailored to political and scientific agenda rather than benefiting society (Jasanoff, 2005a). Policymakers' decisions during risk management cannot therefore be considered as neutral; they are a result of political compromise and careful boundary maintenance, during which certain views are prioritised at the expense of others (Jasanoff, 2016). Jasanoff argues 'social contracts' can be in play between science and politics to 'steer' scientific findings into political goals and to set boundaries on biotechnological risks (Jasanoff 2005, p. 226). This has also been argued by Stirling (2010, p. 4), who suggests that we should explore presented risks beyond the 'single definitions presented by science that are most amenable to political manipulation'. There are as such, differences in how nations look at a set of events and who's views fall inside the frame.

This becomes clear if we examine how countries across the world have problematised the risks involved with Antibiotic Growth Promotor (AGP) use in food producing animals. The scientific evidence produced by the UK Swann 'scientific expert' committee in 1969 warned about the public health risks involved with AGP use in agriculture and advised to phase out their use. Since, European countries started to phase out AGP use in agriculture at different paces (Kahn, 2016). In Sweden, the government responded to farmers who wanted to ban AGPs, as farmers believed that consumer concerns about AGPs would affect agricultural markets. Callon (1986) has defined this as the 'Sociology of Translation': actors who were previously unconnected can reconcile around a 'matter of concern', by sharing the same problem-solution definition or Obligatory Passage Point (OPP). AGP use as 'concern' reconciled Swedish policymakers, scientists, farmers, vets and consumers, who agreed together that banning AGP use would serve everybody's interest. As such, Sweden was the

first country to ban AGP use in 1986, followed by other Nordic countries in the two decades that followed (Cogliani et al., 2011). However, as will be extensively discussed in chapter 3, resistance in Europe to the scientific claims made by the Swann Committee from farmer lobby groups and pharmaceutical companies, allowed for a continuation of AGP use in the two decades that followed (Kirchhelle, 2018). Due to a series of events during the late 1990s, from food safety scandals to new groups entering the scene, AGP use was eventually banned across Europe in 2006. In contrast, the US agricultural lobby successfully fought against AGP legislation up until 2017 (Kahn, 2016). The public risks involved with AGP use were continuously counteracted by The American Farm Bureau Federation (AFBF) (Kahn, 2016). Global pressure from international organisations finally made the US decide in 2017 to ban growth promotor use.

We find as such opposing science claims, characterised by the ‘circumstances of their production’ (Sismondo, 2010, p. 11). What becomes clear is that the apparatus of politics is not designed to democratically collect, present, confront and evaluate different concerns. Rather, politics makes certain versions of risks attributed to livestock AB-use visible, while silencing others. How nations define and use scientific evidence determines how nations respond to bio-objects under debate and the concerns at stake, rather than objective facts discovered over time. The structural agency of nations/groups that steers how individual people respond to technological/environmental risks has also been discussed by anthropologists Mary Douglas and Aaron Wildavsky in their Cultural Theory of risk (1983). This theory seeks to explain how structures of social organisation steer individuals perceptions of risk and how this reinforces structures in competition against alternative risk perceptions.

Having established how nations can have different ‘matters of concern’ associated with the bio-object under debate, in accordance with their political culture, I will next introduce the characteristics of the UK’s political culture.

#### 1.4.3 The UK’s political culture: expert committees

Jasanoff (2005) has characterised the UK’s institutional framework as a technocratic political culture, by which she means that scientific experts inform scientific debates. These scientific expert committees are presented as providing independent and impartial advice to the government. Scientific experts in the UK enjoy a widely respected status of ‘character, experience and technical expertise’, and provide ‘narratives of reassurance’ to the public, that the problem is under control (Jasanoff, 1997, p. 228). In cases of scientific uncertainty, expert committees are used by the government to inform policy and settle concerns. This is in contrast to, for example, Sweden, where scientific evidence will be evaluated by other experts and non-

experts to democratically discuss how to act. The difference in political culture between the UK and Sweden will be discussed extensively in Chapter 3. Taking an STS position, Jasanoff (2015) argues how these scientific experts and their methods do not stand outside the politics of what is desirable, prioritising certain interests over others (Jasanoff, 2016).

The Bovine Spongiforme Encephalitis (BSE) crisis in 1990s is a good example of how scientific experts and their evidence became tailored to the interests of agricultural lobby, rather than consumer safety (Jasanoff, 1997). During the crisis, scientific experts chosen by the UK government to assess the public health risks attributed to BSE dismissed BSE as risk to human health, although other scientific communities warned about the association between BSE and the human Variant Creutzfeldt-Jakob disease (vCJD) (Hinchliffe, 2001). There was an infamous incident where a British politician fed a beef burger to his daughter, in which beef was declared as safe to eat by the British government, protecting the farmer economy (Jasanoff, 1997). In contrast to what the British government had advised, it turned out BSE was transmittable from beef into the vCJD in humans, with deaths among infected people. Concerns emerged about the *meaning* of expertise in relation to the management of complex issues (Jasanoff, 1997). The silencing culture of experts and policymakers, entrenching the lay-expert divide, became questioned by several non-scientific members of the public, who felt ignored by policymakers (Irwin, 2006; Jasanoff, 1997). To bridge the lay-expert divide, a political reform took place for a new mode of scientific governance (Irwin, 2006). Public dialogue, transparency and democratic engagement on risk became the new pillars of scientific governance. The former reliance on committees of technical experts became replaced by a model of science and society (Irwin, 2006). However, Irwin (2006, p.302) questions this new 'social contract' between lay-expert groups, in that the power of experts will not simply disappear by including non-experts in the debate.

Taking the former discussion into account, I am interested to explore the process of regulatory decision-making between experts, policymakers, industry policymakers and non-expert groups (farmers, vets, consumers). How was livestock AB-use made into a 'matter of concern' across policy settings, by whom and what was *at stake*? How were alternative viewpoints considered and articulated in the UK during processes of livestock AB-use governance from the 1960s onwards and how was regulatory consensus achieved?

#### 1.4.4 Studying the implications of the UK's industry-led approach

##### **The 'co-production' of human and microbial worlds**

By understanding the UK's political culture in terms of agricultural AB governance, this will allow me to study what counts as evidence of progress in livestock AB-use to policymakers, and what interpretations of evidence are acceptable. Importantly, policy frames are not static entities that provide a snapshot of the world. The way in which nations frame events has consequences; it shapes the world (society and nature) we come to live in. Jasanoff (2004) refers to this as the idiom of 'co-production'. Our understanding of problems and how we respond to them simultaneously shapes the natural worlds we live in: nature and society evolve together. The idiom of co-production is useful in AMR contexts, as it allows me to examine what the consequences are of adopting a particular risk frame to govern issues. Not only does the UK's industry-led approach result in certain AB practices, these practices simultaneously co-produce how microbes and their ecologies respond to these practices. Human responses and microbe responses are acting together, evolving together, co-producing each other's worlds. It matters to examine how policy frames translate into practice and their implications on social and natural worlds (Jasanoff, 2005).

Having established the limitations of scientific methods to evaluate policy impact, the second part of this thesis will examine how livestock industries take up their responsibilities and *practice* the policy expectations. I will explore how the UK industry-led approach performs new social and natural worlds. In order to do so, I will use the UK dairy industry as a case study. Although the pig and poultry industry are considered as the high users, at the start of this PhD in 2015, the dairy industry had high prophylactic use of ABs, high HP-CIA use, and lacked AB usage monitoring systems (RUMA, 2017). As the UK dairy industry had no clear overarching AB policies in place, this served a good case study to start tracing how this sector and its actors take up responsibilities and implement responsible AB-use policies. With livestock ABs as central objects of study, my interest was to explore how dairy actor-networks interpret the risks of livestock ABs, and how this shaped policy, practice and nature. Moreover, the object-centred approach enables me to study how dairy actors (producers, milk processors, retailers, vets, dairy organisations) and other non-human actors (animals, technologies, markets, educational tools, microbes, etc.) build *together* cognitive and material worlds, instead of reducing this into human endeavour (Knorr Cetina, 1997, p. 1). I will next elaborate on how I will study dairy actor networks as a relational activity.

## **Antibiotic decision-making in the UK dairy industry as Actor-Network activity**

My approach to studying AB decision-making as an actor-network activity is situated in Latour's Actor Network Theory (ANT) (Latour, 1987, 2005). ANT, as a particular theoretical framework within STS, was developed in the early 1980s by Michel Callon, Bruno Latour and John Law (Sismondo, 2010). Its origins are situated in ethnographic studies of laboratories, to study how science and the creation of scientific knowledge is a social activity between researchers and their laboratory environment (human and non-human) (Sismondo, 2010). ANT opposed itself to social theories that focus on either the study of human actions at micro level, or the study of social structures (such as institutions, class, gender, law, etc) at macro level, to explain social orders (Latour, 2005). ANT was one of the first theories that withdrew from nature/society and agency/structure debates in social theories. Proposing a sociology of associations instead, ANT argues that the social should be traced in associations between human and non-human actors. Instead of having individual agency, humans and non-humans are *made* to act by each other; they are interdependent (Latour, 2005).

The latter is important, as it means that decision-making of dairy actors cannot be approached as an individual, rational act. Instead, dairy actors are part of actor-networks that influence their AB decision-making. Examining the dairy AB actor-networks of dairy producers, milk processors, retailers, dairy organisations and dairy vets will therefore be an important part of this research, as it will help me to understand which actors drive AB decision-making within and/or across the dairy AB networks. Fox (2011, p. 858) argues, that to understand what makes actors act and how power is dispersed, we need to trace the actors in action, from 'within a situated activity.' 'Existence' is what needs to be explained in analysis, by the study of practices (Fox, 2011, p. 858). This is an important methodological consideration, as it forces me to think beyond causality and study what makes actors act and become powerful (or not) according to *their* actor-networks. Some of the actors that are aligned to ABs might overlap, while some actors might be unique to the actor-network of the particular site/actor. For dairy organisations, for example, statistical evidence (as a non-human actor) of AB reduction is of high importance. For farmers, keeping the cow healthy is potentially of bigger importance than producing statistical evidence of progress. This might lead to different practices of AB policies, affecting both social and natural orders. How dairy actors respond to the risks attached to dairy ABs co-produces AB practices and microbial responses. Moreover, the former approach will enable me to understand how the UK's industry-led approach performs in practice; how it is aligned with the local actor-networks, and consequently, its intended and unintended social and natural consequences.

## 1.5 Aims and objectives

The overall aim of this study is to examine how livestock AB-use was problematised across policy landscapes, how this resulted in a particular framing of the issue, and how this translates itself in practice. To do so, I will turn away from evidence-based models that are used in the UK to both frame and master the issue of livestock AB ‘overuse and misuse’. Instead, I will take livestock ABs as the centre of my research, and trace them across policy, supply chains, producers and veterinary networks. I will examine how AB decisions are made across and within the actor-networks of the previous actors, and understanding what is at stake by studying which actors drive AB decision-making. This will allow me to discuss how these actors could become potential sites for intervention. The objectives are:

- My first objective is to compare the historical political cultures governing livestock AB-use as a public health risk in the UK and Sweden, between the 1950’s and 1990s. I will examine how these two countries use science to inform the governance of livestock AB-use and how interests, values, priorities drive policy decision-making. I will evaluate how this has looped back on the material and social order of AMR.
- My second objective builds from the first objective, and aims to study how the UK’s political culture ‘co-produced’ the governance of livestock AB-use from the 1990s onwards. I want to know what was *at stake* during this process and how this has resulted in a voluntary industry-led approach.
- My third objective involves studying an industry-led approach in practice beyond statistical realities. Taking the dairy industry as the sector of interest, I want to know how dairy actors make decisions upon livestock AB-use as matter of concern according to *their* agricultural networks. Moreover, I am interested to study how the practices of policies impact upon livestock AB-use as a public health risk.
- My fourth and final objective is a methodological objective; I want to provide a novel approach in how we can study the efficacy of AB interventions in livestock AB-use. This will hopefully contribute to new scholarship in this area to inform policy frames that circulate today.

## 1.6 Overview chapters

After the methodology chapter, the thesis can be divided in two sections underpinned by their theoretical approach. The first section includes chapter 3 and 4. In these chapters I will work with the previously discussed concepts of ‘political culture’ and ‘matter of concern’, to study how decision-making about livestock AB-use as public health risk in the UK has taken/takes place. The second section includes chapter 5, 6, and 7 in which Actor Network Theory will be used to study how decision-making on AB policies and their practices takes place in the dairy industry. The thesis ends with a discussion and policy recommendations.

### **Chapter 2: Methodology**

The methodology chapter will describe how I have used a multi-sited ethnographic approach to explore livestock ABs as the central objects under study. I will describe how I followed livestock ABs and dairy ABs during their journey between experts, policymakers and dairy agricultural networks. I will detail the methods I used (document analysis, interviews, and observations) and provide details of how this shaped my research journey. Staying faithful to the concept of ‘co-production’, I will situate the relationship between myself as researcher and my research as an ‘expedition’.

### **Chapter 3: Comparing the historical risk governance of livestock antibiotic use between the UK and Sweden**

Using historical scientific literature, policy documents and newspapers, I will explain how the political cultures of the UK and Sweden historically framed livestock AB-use as a risk and how this has ‘co-produced’ the livestock AB infrastructures in both countries. Using Sheila Jasanoff’s concept of ‘political cultures’, it will be argued how the UK and Sweden have different ways of dealing with livestock antibiotics as public health risks, which results in different practices of livestock antibiotic use.

### **Chapter 4: Antibiotic use in the UK’s livestock industry as ‘matter of concern’**

This chapter combines policy documents and interviews with agricultural policymakers. I will discuss from the 1990s onwards how the UK made decisions upon its governance of livestock antibiotics. Using Callon’s (1987) concept of ‘matters of concerns’, I will discuss circulating political and economic interests of experts, policymakers and agricultural groups, and how this resulted in the UK’s industry-led approach. The intended and unintended effects or ‘overflows’ of these dynamics, characteristic to UK’s political culture, will finally be examined.



### **Chapter 5: An introduction to the UK dairy sector and its regulation**

Using existing literature, I will introduce the UK dairy industry and discuss how it is regulated. I will discuss the historical shift in dairy sector regulation from state-producer to milk supply chain control and how this was part of European food safety crises and re-definitions of food quality. I will show how this has resulted in private quality assurance systems through which the UK dairy supply chain is regulated. Important human and non-human actors in the dairy supply chain networks that make up milk quality and milk safety will be introduced. As will become clear in the next chapter, dairy supply chain actor-networks co-produce antibiotic policies and their practices.

### **Chapter 6: Dairy antibiotic policies and their practices**

Using fieldwork data, this chapter will discuss how the UK's approach towards livestock antibiotic governance translates to local practices. Following an industry-led approach in action, this chapter will start with a discussion of the UK dairy sector's response to political pressure. I will discuss types of interventions, what is prioritised and who is made responsible to show what is expected from dairy supply chain members. I will discuss next how the UK dairy supply chains and their private quality assurance systems take up their responsibilities. Using Bruno Latour's (1987) Actor-Network Theory, I will trace which actors in the dairy supply chains *matter* and how this shapes the UK dairy supply chain antibiotic policies and their practices. The overflows of dairy antibiotic policies and their practices will be furthermore discussed.

### **Chapter 7: Dairy antibiotic decision-making in practice**

Using fieldwork data, this chapter will show how dairy antibiotic decision-making by farmers and veterinarians takes place. While national policy and local dairy antibiotic policies aim to rationalise behavioural antibiotic activities of farmers and veterinarians, I will use Actor-Network Theory to expose which human and non-human dairy actors influence antibiotic-decision making outside the realm of policies.

### **Chapter 8: Discussion and conclusive remarks**

In this chapter, I will bring together the findings of the previous chapters. I will discuss the implications of UK's voluntary industry-led policy frame and discuss its tensions with livestock AB-use as a public health risk. Moreover, I will provide policy recommendations and areas of concern that warrant further research.

## **Chapter 2**

Methodology chapter

# The ethnographic journey: tracing antibiotics on the move

*“Method goes with work, and ways of working, and ways of being”* (Law, 2004, p.10).

In this chapter of the thesis, I will introduce how I engaged with my research field and how my research focus and methods were shaped during this process. With my qualitative constructivist approach as point of departure, I will discuss my adoption of an ethnographic methodology. Following ANT literature, I will use the metaphor of ‘tracing’ to position livestock/dairy ABs as my central study objects and ‘follow’ them across sites where they bring me. Thus, the ‘tracing’ metaphor allows me to deal with my research as an ‘expedition’, beyond the security of research boundaries. With tracing as an *active* process, I not only observe but participate in the production of this expedition. Thus, I will discuss how I approached the research field, its inhabitants and how I ordered my research data. This chapter deals with the decisions and interpretations I made while tracing livestock ABs, of which the outcome will be discussed in the data chapters.

## 2.1 A multi-sited ethnographic expedition

To study the governance of livestock ABs, I opted for an ethnographic approach. This allowed me to examine how knowledge of livestock AB-use is produced across sites, people, objects and organisations and the consequences of this knowledge production. As discussed in Chapter 1, I did not want to measure and qualify established knowledges, but to understand livestock AB policies and their practices in the UK beyond the borders of behaviours. I used the work of Bruno Latour (2005), Michel Callon (1986, 2009), John Law (2004), Annemarie Mol (2002) and others theoretically aligned with ANT. Their multi-sited ethnographies, with technologies and their network constitutions as centres of attention, differ from more traditional ethnographies.

Traditional ethnographies study people’s actions and accounts in everyday contexts instead of experimental settings (Hammersley & Atkinson, 2007). They are most often single-sited ethnographies, demarcated in advance to study the situated human experience. The origins of ethnography lie in the nineteenth century and are situated in old colonial projects (Hammersley & Atkinson, 2007). Travellers and missionaries studied ‘primitive’ societies in order to teach them Western values (Faubion, 2007). During the twentieth century, ethnography became a

methodology used by anthropologists to go native for a considerable amount of time outside the West and study people and their practices in their natural settings (Patton, 2002). The world was studied in its natural state, with the researcher only observing without participating in it. Humans were regarded as the primary agents and their 'intimate knowledge' with the world needed to be studied (Marcus, 1995, p. 99).

This naturalistic approach, in which the 'objective' researcher studied the culture of native people, has however become criticised over the course of time by anthropologists themselves as being un-reflexive (Marcus, 1998). It became since remoulded by various sociological theories, such as functionalism, hermeneutics, Marxism, constructionism, feminism, post-structuralism, and also STS (Hammersley & Atkinson, 2007). Today, ethnography can be conceptualised as an approach to its subjects, with culture and context operating as its key concerns (Cooper, 2012). Decisions about sampling, such as who to interview, will evolve as the research progresses. *Doing* ethnography means that in many cases, the interests and research questions might be refined or even transformed during the research (Law, 2004). Harris (1971) argues how anthropologists are able to develop a particular perspective about human life during their observational journeys. By constantly analysing the observations while they unfold instead of merely reporting, categories of interpretation evolve during the process of data collection and data analysis. The ethnographic process is as such relatively unstructured while the researcher is not constrained by classical fixed research design and pre-defined categories of interest (Harris, 1971).

Importantly, doing ethnography in STS/ANT involves a different methodological approach than classical ethnographies. Hess (2001) distinguishes between two generations of ethnographies in STS. The first STS/ANT ethnographies evolved during the early 1980s as a response to ethnographies that only studied humans and their social activities. Due to legitimacy of science and its 'objective' methods, scientific practices were left unexplored. Questioning however the value-free notions of scientific facts, STS was interested to study the natural sciences, and it was at that time that the first laboratory ethnographies emerged (Bijker et al., 1987; Latour, 1987; Latour & Woolgar, 1986).

*“While ethnographers were quite capable of retracing the links that bound the ethnosciences to the social world, they were unable to do so for the exact science”*  
(Latour, 1993)

Moving into the laboratory, STS scholars took scientific controversies of a technology under discussion as the point of departure. Using an ethnographic approach, STS entered into

laboratories and followed the scientists, in order to understand how social and technical practices constituted scientific facts (Sismondo, 2010). The construction of knowledge was studied beyond human activities, taking into account the agency of non-human actors (from techniques, texts, lab animals, pathogens etc.). The second generation of STS ethnographies moved beyond the laboratory and examines the production of knowledge and technology outside laboratories, in hands of lay groups, media, activists and more (Hess, 2001). Their research tends to be multi-sited, examining the variety of knowledges across sites and actors instead of being limited to scientific experts in their laboratory settings (Hammersley and Atkinson 2007). As my ethnographic interests are situated in AB knowledge practices (Mol, 2002), the handling (politically, economically or physically) of livestock/dairy ABs could be expected to differ between sites. The practice of ‘tracing’ ABs involves asking the question: what are the complex relations that AB practices raise across sites?

A multi-sited ethnography tackles the bounded territories of single-sited ethnographies (Marcus, 1995), and allows researchers to follow the movements of ABs as the ethnographic object of interest (Latour, 2005). In this journey I proposed to trace heterogeneous entities (humans, non-humans, organizations, documents) to understand how livestock ABs are constructed and used. This approach involved a willingness to pursue connections and circulations among actors beyond boundaries (Hine, 2007); it involved following livestock/dairy ABs across controversies, documents, tv documentaries, scientific programmes, conference sites, farms and more. In line with this approach I traced livestock/dairy ABs to the sites where *they* brought me, including both human and non-human actors. The sites were treated as fluid, interactional and unstable (Murdoch, 1998). In the context of this thesis, tracing involves as such a fluid activity, following livestock/dairy ABs across controversies, policy documents, tv documentaries, scientific programmes, conference sites, agricultural organisations, veterinary practices, farms and many more. The tracing metaphor becomes my methodological tool to guide my expedition, allowing me to enter every site with wonder without seeking for truth (Latour, 2005). Knowledge is considered as active, continuously evolving to what we as societies come to see as truth. My research as such does not involve finding truth, but instead describe how truth upon ABs is ‘enacted’ or ‘performed’ (Mol, 2002, p. 33): how are AB statistics produced and what do they represent? What do these statistics mean once opening up their scientific facts? As Annemarie Mol argued in her ethnography of how atherosclerosis is ‘enacted’ in Dutch hospitals (Mol, 2002, p. 5):

*“The driving question is no longer “how to find the truth?” but “how are objects handled in practice?”*

Ethnographers often employ a variety of qualitative methods, tailored to the demands of the research site(s). This strategy is sometimes referred to as triangulation, in which more than one method of data collection is used (Barbour, 2001). The methods usually involve observation (participant or non-participant) as the main method (covert or open), complemented with other methods such as in-depth interviews, focus groups, the study of material (documents) and may include quantitative approaches such as questionnaires (Green & Thorogood, 2004). In this study, triangulation was used in a flexible manner in accordance with the sites of a multi-sited ethnography. This meant that in some sites I requested documents, interviews, observations, focus groups or a combination of any of these. The selection of different types of data for my study was based on what I needed to know; not on a strategy designed before entering the field. I will discuss this process more detail in the following sections.

## 2.2 Preparing the expedition

Marcus (1995, p.113) argues that conducting multi-sited ethnographies can evoke ‘circumstantial activism’ of the observer in the research field: exploring different sites may evoke different personal interests, shaping how these sites will be examined. Equally, Law (2004) has situated the co-production between research and researcher in his STS methodology book ‘After Method’, in which he argues that methodology and data re-produce each other. As such, the type of people, sites, objects that I encountered shaped the choices I made. My own agency as a researcher mattered, as I was in the end in charge of the expedition and the selection of sites to be explored. In this Chapter I aim to provide an account of my expedition which would enable any outsider to understand the choices and decisions I made along the way. As I question knowledge practices, it is important for me to acknowledge my *own* knowledge practices. As ANT suggests, researchers do not act in a vacuum; they are part of networks that co-produce interpretations and actions (Latour, 2005). In what follows, I will discuss my encounters and choices in chronological order as much as possible, although in some cases, I will show how methods overlapped.

## 2.3 Exploring sites

### 2.3.1 Tracing back antibiotic controversies

At the start of my PhD in October 2015, I was surprised to find there was no official regulation in place in the UK to nationally control the use of ABs in food supply chains. I was biased, as I came from a country (the Netherlands) which had just experienced the implementation of a

government-industry led AB reduction strategy across its livestock sectors. Embedded within this were official targets, rules and a national surveillance system. I was surprised that two European countries (the threat of Brexit was no reality yet) could differ so greatly in their regulatory approach. With this in mind, I wrote my research proposal and ethics application in the first half year of my PhD. As I was interested in studying contrasting regulatory approaches to livestock AB governance, my initial proposal involved a country comparison between the UK, the first country in which a critical report on the risks involved with livestock AB-use was published (The 1969 Swann Report) and Sweden, the first country in which the use of AB Growth Promoters (AGPs) in 1984 became banned. While waiting for the UK ethics approval in the months that followed, I turned to historical documents to understand how livestock AB-use was problematised in the UK and Sweden.

Latour argues (2005, p.27) we should always start in the ‘middle of things’ in order to track who is involved, what identities are made, and how solutions are framed at dispense of other solutions. I trace’ back to when livestock ABs were first problematised in order to map out controversies (Whatmore, 2009) on livestock AB-use in both countries. Anthropologists traditionally frame records, documents, artefacts and archives as material culture, as it provides detailed information about the workings of organizations and programmes (Patton, 2002). Documents moreover structure what the discourses are, who they represent, what new discourses emerge, and finally what other groups and documents the documents constructs. I started to trace primary sources, including European, UK and Swedish policy documents, UK newspaper articles of ‘The Daily Mail’ and ‘The Times’ and the UK veterinary journal ‘Veterinary Record’. These documents took me back to the 1950s. I visited the British Library in London in order to access old newspapers that covered the time period. Secondary sources included scientific journals and books. Following the methodology of a discourse analysis, attention was paid to what was said by whom in order to capture the co-producing effects of discourses and identities. This allowed examination of how farm ABs in both countries became institutionalized in relation to both countries political cultures. It was during this process that I came familiarised with UK’s use of ‘scientific experts’ to settle AB controversies. But also, that countries differ in how they use science and that there are politics involved in how knowledge was produced upon livestock AB-use as risk.

This preliminary reflection upon my discourse analysis upon both countries produced new sites of interests, from scientific experts to policymakers, policy documents and the agricultural sectors themselves. However, as we will see, I was about to come across important crossroads in which I had to make decisions about the direction I took.

### 2.3.2 Tracing unfolding antibiotic controversies

As my multi-sited ethnography involved tracing livestock ABs to the sites, I had to track different leads at the same time. A major event during my desk based discourse analysis had caught my attention. You could argue that I was lucky, as I was about to enter into the midst of a controversy. As discussed in the theory section, STS scholars use the midst of controversial debates as an opportunity to explore what is at stake and what claims are made by participants and their opponents (Sismondo, 2010, p. 125). The UK O'Neill expert committee published in December 2015 and May 2016 controversial reports, critiquing the 'overuse and misuse' of ABs. This provided me with an opportunity to explore if and how the O'Neill review would become an important actor in my expedition. I was particularly interested in the following set of questions - How the O'Neill reports frame the problem and which arguments were used? Who were the opponents and what counter claims did they make and why? Sismondo (2010) offers five ways to explore how actors take over controversies by deploying certain strategies:

1. They give detailed critiques of observations, experiments and positions
2. They introduce new tests, and calibrations of instruments and procedures
3. They isolate one position as more scientific or central – or as deviant
4. They show one position to be more useful
5. They ignore deviant viewpoints and data

According to Callon (1986, p. 8), scientific controversies are characterised by 'trials of strength', during which scientists try to 'impose and stabilise the identity of the other actors it defines through its problematisation'. The midst of controversies offers as such the opportunity for researchers to study who is claiming what and why. Moreover, controversies leave 'unexpected' trails, and allow to trace new social connections (Latour, 2005, p. 43).

When the O'Neill expert report in 2015 was published, attacking global and national livestock AB-use, it was the perfect moment for me to step in the controversy and follow what truth claims were made by whom. Opponents to the 2015 report presented themselves, such as the representative organisation for the Animal Medicines Sector in the UK (the National Office of Animal Health [NOAH]), the British Veterinary Association [BVA], and the livestock sectors' overarching agricultural organisation Responsible Use of Medicines in Agriculture Alliance [RUMA]. They became important initial ethnographic sites for me to trace. To understand however the unfolding controversy, I had to not only monitor it, but trace back what was *at stake* to the groups who made opposing claims. In the early stages of my research I relied on documents to trace back the role of groups such as RUMA, BVA, NOAH in the early debates in the UK on livestock AB use. Using the online web archives I reconstructed how positions



and arguments of the different groups had taken shape and informed the current debate. This was an important exercise at the time, as it forced me to understand the workings of the agricultural industries in the UK

### 2.3.3 Conference sites: exploring debates

To keep informed on industry ‘knowledge practices’ about livestock ABs, I connected myself online to the twitter feeds of RUMA, BVA and NOAH. Through this connection I found out about a conference entitled ‘Antibiotics and Farming: Prescriptions for Changes’, (14<sup>th</sup> of April 2016), organised by the UK AB advocacy groups Medact, a London-based global health charity, and the Alliance to Save Our Antibiotics. The conference brought together policymakers, health professionals, agricultural stakeholders, environmental groups and civil-society groups to discuss how farm AB-use could be reduced. This offered a great opportunity for me to listen to and observe the documented and online debates as they were played out in practice.

It became apparent during the conference that the debates on livestock AB-use in the UK were dominated by a selected group of organizations who acted as spokespersons for the involved industries at large. These organizations were RUMA, the BVA, and the Soil Association. They appeared to adopt multiple roles, not only representing their own organisations, but circulating in different networks; from agricultural networks, to pharmaceutical networks, policy networks, scientist/university networks. This provided me with a focus on understanding how these networks functioned and how they produced knowledge about the risks of livestock ABs to human public health.

## 2.4 Tracing the actor-networks of dairy antibiotics

### 2.4.1 Meeting key informants and key organisations

By the end of the summer 2016, my research received University of Liverpool ethics approval. The undertaking of the documentary comparison between the UK and Sweden had enhanced my knowledge of the political cultures and the agricultural industry in both countries. However, in the course of this I had begun to realise that extending my empirical work to Sweden was over-ambitious and would limit my ability to understand the processes of AB-use in the UK. I therefore decided to focus the research on livestock AB-use in the UK. I still kept the field open to the UK livestock sectors and ideally, still wanted to compare them all in their AB knowledge practices. However, as I will show, the explorative nature of ethnography in

combination with my tracing activities would point me towards one livestock sector in particular.

Fortuitously, at the beginning of October 2016, I interviewed a key informant, a veterinary surgeon specialised in dairy herd health with links to a large retailer (Veterinary surgeon 19). The interview was semi-structured (see Appendix 3) with a list of pre-defined broad topics to stimulate discussion (Green & Thorogood, 2004). Although I used the sets of questions as guideline, we ended up talking about a variety of topics that concern dairy AB-use, opening up new traces. I learned about the complexities involved with regulating dairy AB-use, and the vet provided me with important new human and non-human actors, such as milk contracts, milk residues, milk prices, retailers and milk processors. Being important non-human actors, they forced me to pay attention to them. An invitation to the 'BioInfect' conference (October 2016) in Cheshire allowed me to hear from Sir Lord O'Neill. This 1-day conference critically discussed human and animal industry related R&D issues of diagnostics and AB alternatives. At the conference, I was introduced to agricultural representatives and other key informants who were willing to participate in my research. Before I will discuss this more in depth, I will discuss how I recruited veterinary surgeons and how this shaped my research trajectory.

#### 2.4.2 The first interviews: Veterinary surgeons

During the first stage of my recruitment period, I recruited three vets at the University of Liverpool, (1, 17, 18) who had either worked as vets in livestock sectors or were still working part-time as vets in practice. As I had hoped for, one of them referred me to other veterinary colleagues working full time in practice (Veterinary Practice 1 and Veterinary Practice 2). Another one referred me to a livestock industry organisation 3, with whom the vet had contacts with. This resulted in an interview with this livestock industry organisation in the months that followed. The formal activities (executed for every interview) of the interview recruitment procedure included an oral or email invitation. Once potential participants had agreed to the interview, we set a date and time. I sent the interview guide (Appendix 3) in advance of the interview so that interviewees could prepare themselves. The interviews were either held face-to-face in a convenient setting, over skype or the phone to save travel budget, and ranged from 45 minutes up to 2.5 hours. The interviews were recorded and the same day transferred to a password protected hard drive. The participants were given a pseudonym and interviews were either transcribed by myself or sent to a transcribing centre. The transcripts were saved on the University Server to protect it again from unauthorised access.

A limitation of interviews according to qualitative researchers is that what people *say* differs from what they *do*. It does not mean the interview data is invalid, but it is a 'normative account'

of reality (Green & Thorogood, 2004, p. 102) As the interviews with vets progressed I became interested in the number of discourses within which ABs sat. As a result I decided I needed to witness AB practices by vets and farmers more in detail. I wanted to trace what was *done* during AB practices through the method of observation. By the beginning of my second year of the PhD, my ethnographic journey had become set on a study of dairy AB policies and their practices.

### 2.4.3 Non-participant observation: tracing the Actor-Networks of dairy antibiotics

Observational methods allow researchers to observe phenomena in relation to their sites of action. This was an important element of my research, as I wanted to observe how dairy AB realities are assembled, instead of trying to make sense of their singular presented version presented by science (Latour, 2005). It allowed me to get to know the dairy ABs in relation to their agricultural actor-networks, instead of ‘knowing about them’ through their representatives (documents, policymakers, dairy spokesman, AB-users) (Green & Thorogood, 2004, p. 132). Observation complements data derived from interviews, as observation situates what is said about the object in its natural setting. Researchers can decide to take an overt role in which people are aware they are being studied (referred to as participant observation), or take a more covert role and not expose themselves as researchers in the research setting (Patton, 2002). A concern with overt roles is that this can interfere with the natural behaviour in the research site. The covert observation role has to deal with the ethics of secrecy, as private behaviour is being studied. I have taken a non-participatory, overt approach in my own observational fieldwork, and this made reflexivity about my influence as researcher an essential part of the ethnography. This is in line with Law’s (2004) ‘After Method’ methodology, in which he argues that we need to reflect upon how the field and researcher have co-produced each other. In order to keep track of my observations, feelings and reflections, I kept my research diary with me in which I wrote down findings whenever the environment allowed me to. This field notebook represented my data collection of the ethnographic fieldwork. Another dimension in how observational studies can vary is the length of the observation period. Traditional anthropological ethnographic studies expect researchers to spend at least six months and often a year or more in a culture of interest in order to grasp its local dynamics and unveil the complexities of social life (Savin-Baden & Howell Major, 2013). However, the time of the observation period depends on the research aim and questions of the study rather than of some pre-defined ideal of length (Savin-Baden & Howell Major,

2013). I will explain next how I performed my observations and how they further shaped my research journey.

### **Retailer-farmer meetings**

I attended 10 dairy retailer-farmer meetings on AB policies across the UK in the period of January and February in 2017 (See Table. 2.1). With consent from the retailer, I was able to observe during the meetings how the retailer, in collaboration with its milk processors, transferred new AB policies informed by the ‘O’Neill’ targets to their contracted farmers. During the observations, I made notes in my research diary processed the same evening in a word document on my laptop. To evaluate the implications of the presented policies, I tried to speak with farmers before and after the meetings. Some of the farmers thought I represented the retailer and felt initially uncomfortable sharing their thoughts about the retailer. By explaining my role as a researcher assured them I was acting independently from the retailer. Once I had established my research role, some farmers opened up and were willing to share with me with their thoughts about the retailer activities. One of the farmer spokesman (Farmer 1), involved with the retailer policies, invited me to his farm for a 1-1 interview. Vets were also invited to attend the meetings, enabling me to study the interaction between the different supply chain actors. During each farmer meeting, a small number of vets were present. I was mainly interested in finding out how actor-networks were built between the retailer and milk processor representatives, ABs, policies, farmers and vets. What became apparent to me during the meetings was that retailers and milk processors played crucial roles in how AB infrastructures developed. My role started to change from a non-participatory observant to a semi-participant observant when I was asked to evaluate the AB policy presentation of the retailer. My own presence as researcher started to contribute as such to the format and content of the retailer-farmer meetings. I started to *matter* in the retailer-farmer actor-network, contributing to its ontology (what is out there). Over the course of the 10 meetings, I integrated more and more with the team by travelling with them, discussing meetings and presentations over meals. I was moreover able to hear some of the ‘gossiping’ about the ins and outs of the supply chain liaisons. As there are many different dairy supply chain liaisons in the UK, circulating in different agricultural networks, one of my next tasks was to start recruiting more retailers and milk processors.

### **Observing veterinary practices**

Although I initially wanted to undertake six weeks of work shadowing veterinary practices, spread over three veterinary practices in the North-West, Midlands and South/South-West of England, difficulties accessing veterinary practices forced me to change my plans.

Connections via my research team enabled me to perform three weeks of participant observation in a veterinary practice in the North-West (Veterinary Practice 3). One veterinary practice in the South (Veterinary Practice 4) agreed for me to spend one day of observation with one of the partners. Although I had approached several veterinary clinics via phone, via email, via vets I had met during farmer retailer meetings, and through an advertisement in a monthly veterinary magazine of a veterinary cooperative, I was not able to recruit another veterinary practice willing to let me work shadow their AB activities. It was a frustrating and uncertain time period, but it was at the same time part of the fieldwork experience.

### Veterinary Practice 3

During the participant observation period of three weeks at the first veterinary practice, I was able to follow every vet (Veterinary surgeon 6-15) in the practice for at least one day, and in some cases for 2-3 days. I interviewed them as well during the car rides, using my semi-structured interview structure. As it felt uncomfortable using my audio recorder, I took notes of the interviews in my research diary. Observations of vets on farms and during their interactions in the veterinary practice were written down in my research diary during the car rides and between visits. These notes were further processed in the evenings and weekends in a word document on my university laptop. Reflecting upon my presence, I felt this did not seem to affect decisions about AB treatment, and vets did not seem at all reluctant to prescribe. However, when I asked if my presence affected their prescribing, they answered that my presence in some cases made them reflect about their AB prescribing choice. In general, the vets seemed very open and eager to let me observe their practices. This was in itself interesting, considering that it was hard to get practices to participate. The partners told me that they initially had disagreement about me coming to the practices. They thought that it could benefit the practice, however, enabling them to reflect them upon their practices. During my observation period, it felt as if they wanted to show me they were actively working on responsible AB-use and that they were proud to share this with me.

My background as a vet could have nurtured their openness towards me, as I was always introduced as a veterinary surgeon or colleague when we entered a farm. The vets often asked me to assist when they were performing activities, such as spraying animals that were vaccinated, handing them materials, writing down fertility and mobility scores, or in some cases doing auscultations or take the temperature of animals. Farmers were also encouraged by the vets to talk with me about their AB practices and their opinions about retailers and milk processors. Again, from a non-participant, I became a semi-participant observer; I became an actor in veterinary and farmers actor-networks. This enabled me to talk to many farmers during my observations, on a wide range of farms, operating in a wide range of circumstances. In some cases, these discussions took place over coffee where the vets also joined the discussion.

In other cases, discussions took place either during the practices of the vet or after when the vet was cleaning and packing his/her equipment. Patton has described this process as the insider and outsider dynamics or the emic versus etic perspective of researcher and field (Patton, 2002). By being an insider of a culture, some anthropologists believe that this gives more meaningful emic perspectives. Others believe that researchers need to be outsiders/ have an etic perspective in order to be far away enough from the particular culture to remain critical (Patton, 2002). In my case, I had never worked as a vet in a dairy practice, although I had received during my veterinary training experience of working with farm animals. Thus, my veterinary background allowed me to access knowledge sites and activities within the veterinary practice as research site, however with enough distance to watch the performance of dairy AB actor networks in their natural habitats. I was also able to interview vets during the car rides, or in the veterinary practices (Veterinary surgeon 6-15). The veterinary partners came together for a focus group discussion, in which I was able to discuss with them their thoughts and actions about dairy AB-use. In other cases, I observed interactions between veterinary vets during their coffee or lunch breaks.

#### Veterinary Practice 4

My participant observation day in the second veterinary clinic in the South had been arranged by one of the farmers (Farmer 3) I had met during the retailer-farmer meetings. The veterinary clinic had a practice mission to stimulate innovation in dairy, from medicine use to herd health planning to prevention. In common with the previous veterinary clinic, there was a publicly stated emphasis on 'responsible AB usage' activities. With the vet (Veterinary surgeon 16) who agreed for me to do the participant observation, we drove around during which I had the chance again to meet farmers and discuss some of their activities. We ended the day with the farmer (Farmer 3) who had referred me to him. This turned into a spontaneous focus group, with the vet farmer and his herdsman discussing activities that involved responsible AB-use. Although it was only one day, I was able to compare the day to some extent with my previous observation period in veterinary practice 1, strengthened my findings and reflections.

#### 2.4.4 Interviewing agricultural actors

Getting access to big companies that are not open to the public and who have commercial interests was not an easy task. As my reading and fieldwork progressed, I had made an inventory of the organisations I wanted to interview. However, this list evolved in response to access issues and as the actors changed during the research. As previously discussed, through the 'Bioinfect' conference in Cheshire, I met key informants who were willing to participate in my research: two livestock industry organisations (Livestock industry organisation 1 and 2)

and a pharmaceutical company (Pharmaceutical Company 1). The amount of information provided by the interviews made me start to prioritise certain leads over others. Although pharmaceutical companies are important players and their market activities important sites for future research, I decided that I would only trace their network activities in relation to the agricultural networks in which I was interested. Market regulations, R&D, patents, business portfolio's and more contribute to how pharmaceutical companies position themselves in agricultural networks, these commercially sensitive networks seemed to me to be too complex for this PhD in the time available.

The previous interviews not only contributed to new leads to trace, but they referred me to acquaintances in the field who agreed to get interviewed. One acquaintance was a key figure in one of UK's livestock organisations (Livestock industry organisation 4), who brought me a new perspective upon how the dairy industry was evolving in comparison to the other livestock sectors. The other acquaintance was again representative of a veterinary pharmaceutical company, who was interested to share opinions (Pharmaceutical Company 2). Although I had decided to not trace the workings of pharmaceutical companies, it still offered me the chance to explore how the pharmaceutical company positioned itself in agricultural networks. As the spokespersons of the pharmaceutical companies I interviewed were vets by training, they shifted between their 'pharmaceutical head' and 'veterinary head'.

During the farmer retailer meetings, I recruited a retailer spokesman (Retailer 2) and spokesman of a UK milk processors (Milk processor 1) for a semi-structured interview. In addition, in response to a recruitment advertisement I had placed in the monthly magazine of one of the veterinary cooperatives in the UK, I recruited an interested vet/consultant (Veterinary surgeon 21). The interview I undertook with this person lasted three hours and became a vehicle for me to test out some of the ideas that were emerging from my research. With interviewee and researcher interacting, we produced knowledge together (Green and Thoroughood 2009, p. 102). This invited me to reflect upon some of the ideas I had developed in the course of my research. Through the previous spokespersons, I was able to recruit Retailer 1, Milk Processor 2 and another vet/consultant (Veterinary surgeon 20) working for another retailer. Although still using my original semi-structured interview guide, we expanded the conversation with the actor-networks I traced during my fieldwork.

Over the summer 2017, I was able to recruit one more vet (Veterinary surgeon 4). During the same time period (late summer) my supervisor was also able to get me in touch with a farmer (Farmer 2), who was contracted by a milk processor whom I had interviewed. In addition, the agricultural network of researcher/clinical vet 1 offered me the opportunity to take part in two farmer focus groups (Retailer focus group 1 and 2) organised by the retailer of whom I attended

the retailer-farmer meetings. These focus groups were designed to evaluate the AB policies with farmers. The design of, and questions used in, these focus groups were, however, not designed by me. I took the opportunity instead to listen to the discussions and speak with the farmers ‘off the record’ before and after the meetings. It provided me with insights in to how the farmers work with initiatives of the retailer, on *and* off the record.

Finally, I tried to get access to policymakers (Veterinary Medicine Directorate (VMD), Department for Food, Environment and Agriculture (DEFRA)) via email, but I did not receive any responses. Although policymakers are an important part of this research according to the controversies I traced, I was not able to explore these within this study. I consider this as a gap in my data. Nevertheless, the other traces had brought me to unexpected new actor-networks, or which their importance was confirmed by other actors along the way.

#### 2.4.5 Closure of my ethnographic journey: witnessing the RUMA-VMD conference

In October 2017, I attended the RUMA-VMD conference on responsible antibiotic use in London, which would be the last ethnographic activity of my fieldwork. During this event, all major livestock sector stakeholders came together in order to evaluate progress on AB policies and the status of responsible AB use in practice. The conference was an important site for me to close my multi-sited journey, as it brought me back to the site from where I started: the controversy of the O’Neill reports and its settlement into responsible AB usage targets. Would I hear some of the same problems in persistent AB infrastructures I came across during my ethnographic journey? How would the UK livestock sectors reflect upon their practices of the policies? The controversies with which I had started this expedition had turned into low profile. Nobody spoke, however, about the tension between policies and practices I came across during my fieldwork. It was time for me to start analysing my data.

## 2.5 Data analysis

### 2.5.1 Transcribing

In accordance with my theoretical position, my data analysis evolved around the generation of data from the fieldwork material instead of using pre-determined models. This inductive approach allowed me to generate patterns, codes and themes by the language and/or topics discussed by the respondents or from the observational data. The first step of data analysis was transcription of data in textual record (Savin-Baden & Howell Major, 2013). In order to situate actor-networks that were emerging throughout the fieldwork, I transcribed interviews as close



to the time they were undertaken as possible. Transcribing my interviews allowed me to revisit my data and spend time with its textual records. The first interviews were transcribed by myself in order to better understand how the interviews proceeded. The transcription followed a 'denaturalised' approach typically used by ethnography and most other social sciences approaches (Savin-Baden & Howell Major, 2013). The aim of this transcription method is on content/information and thus what is said, rather than how it is said (Savin-Baden & Howell Major, 2013). Naturalised approaches, which consider every utterance and body language, is typically used in conversation and linguistic studies that aim to analyse speech patterns in interaction (Green & Thorogood, 2004). Nevertheless, by listening to the transcripts several times I tried to examine moments of ease or unease, doubts, uncertainty etc., as this provided me with insights in how the participant situated their own thoughts. Hearing myself respond to the interview participants and my formulation of questions also helped me to reflect upon how I influenced the interview and what I could improve subsequently. As time proceeded during my fieldwork, some of the anonymised interviews were sent to transcribers for transcribing. When I send interviews for transcribing to transcribing centres, I had to ensure the confidentiality of the records by making the identities anonymous. The transcribing records itself are kept on a secured hard drive space that is only accessible through passwords. The transcribed interviews were checked against the sound files for the interview. This first step of data analysis helped me to familiarise with my data while making notes of what I thought was of particular interest.

### 2.5.2 Coding

For the data analysis, I used a thematic analysis, which involved the identification of recurrent themes in the data that organised my topics of interest. After familiarisation with my data during the process of transcribing and re-reading the transcripts, I started the first stage of thematic analysis which is the coding of the data. Data was 'reduced' in labels or codes which helped me to start comparing transcripts. To help me organize my data and data analysis, I decided to use N-Vivo software as coding tool. N-Vivo is a program used by qualitative researchers which helps to organise, analyse and find patterns in unstructured data. After transferring the transcripts into the program, I began to highlight words/texts of the transcripts into labels, order these labels and compare them across transcripts. Through this approach, topics, metaphors and actors emerged that I thought would be relevance to my research. The code, keyword or small phrase simply highlighted what I thought the section in the text was saying; the next step was to order my codes into broader categories and looking for links between these codes. To do this, I designed a coding framework with main and sub themes.

### 2.5.3 Nvivo

An important part of coding is to continue refining and reflecting upon the codes and themes as data analysis progresses. In my case, I shared my codes and themes in N-Vivo with my supervisors. Although the program of N-Vivo helped me to order data, codes and themes, we found that my coding did not always represent the data in its full account. I first of all focused too much on identifying ‘actors’ that were involved in the construction of AB networks. Secondly, I remained too descriptive and failed to identify patterns and concepts that would help me theorize the data. It was, for me, the first serious crisis of the PhD. My supervisory team decided that there would be time to restart data analysis from the beginning and work with the transcripts without using a software tool. So a next stage of data analysis began.

### 2.5.4 Themes

By reading and re-reading, highlighting and putting notes on the transcript and in a coding diary, I was able to better ‘grasp’ the data and evolve from a descriptive to a conceptual analysis from the data. After analysing a couple of transcripts, I felt more comfortable with the data and I started to bring in STS theories and concepts that supported my data. I also updated my N-Vivo project during the process by comparing my new data analysis with the old data analysis and restructuring where necessary. As my ethnography was multi-sited, I also sometimes struggled using N-Vivo as an ordering tool. The more transcripts and sites I analysed, the clearer in my mind the story I wanted to write became. The data Chapters are written to reflect my ethnographic and data analysis ‘journey’.

## 2.6 Ethical considerations

As this research deals with individuals, groups and research sites, the research had to be approved by the University of Liverpool Committee on Research Ethics before fieldwork was able to start. In any study, it is important to consider how participation may harm the members or sites of research. This is particularly so when the topics studied are sensitive. Informed consent is a central principle to the conduct of UK research. This means that people engage in research as participants of their own free will and when they do so they are aware of the implications of their participation (Green & Thorogood, 2004, p. 57). I designed an informed consent document tailored to the research settings (Appendix 2). During the recruitment stage, the consent document was sent to the participants alongside the information sheet.

However, the iterative process of ethnographic research brought me to sometimes unexpected people and sites of observation. Equally, the semi-structured interviews presented me, in some

cases, with unexpected sensitive topics that were not formulated in the consent forms and/or interview guide. I ensured nevertheless the principles of anonymity and confidentiality. Knowledge of the identity of the participants was limited to my own research team, contact details of the participants were stored on a password-protected computer and participant observation notes and interviews were anonymised to protect the privacy of participants. As the data itself can contain information that can lead to the identity of the participants, I have tried to avoid any reference or attribution that could expose the participant (Ritchie & Lewis, 2003). After completion of the PhD, the records will be destroyed to ensure they will not be deposited for new research.

## 2.7 Some final personal methodological reflections

It is important to reflect on how I, as a researcher, made choices and connections when tracing livestock antibiotics among sites, people and objects. Some sites were more 'active' than others, which produced variety in terms of the intensity and quality of the fieldwork (Marcus, 1995, p. 100). Changing actor sites also meant that I had to immerse myself in complex fields with different interests and opposing claims. To stay committed to the object, I had to reflect continuously upon the life-worlds I entered and the claims that were made by the research participants to legitimate their reasoning or delegitimize others (Hine, 2007, p. 657).

Thinking about my philosophical and theoretical position, I have approached the veterinary profession during my ethnography as an institution made up of human and non-human actors that contribute to AB infrastructures in practice, rather than as a culture made up of human behaviour. It was more important for me to study what particular actors (such as protocols, secretaries, colleagues, veterinary business models, farmers, and cows) co-produced AB actor-networks. A reflection needs to be made as well about the type of veterinary clinics in which I performed my participant observation. Both veterinary clinics belonged to the same large veterinary corporate structure which owns several large veterinary practices across the UK. These corporate veterinary businesses buy veterinary clinics and standardise their brand and services. By belonging to a veterinary corporate structure, the veterinary clinics report that they are able to buy their medicines more cheaply and receive a higher mark up on the medicine when selling it to farmers. Veterinary clinics who do not belong to these veterinary corporate structures do not have this advantage, while at the same time having to compete against them. It would have expanded my research field if I had been able to do participant observation in a non-corporate veterinary practice, to examine how AB actor-networks were performed in their daily practices. Despite my best efforts, this did not come to pass.

One of the most difficult parts of conducting the ethnography was the recruitment of research participants. Throughout my fieldwork, I had many positive recruitment responses, but also many were negative. In particular, I was not able to recruit participants at UK government level. Although I approached these actors, they did not reply to my emails and reminder emails. Similarly, farmer, veterinary organisation, policymakers and veterinary practices equally did not respond to emails. Thinking about my recruitment techniques, I realise I limited my success by sticking to email recruitment. I did not feel confident in the beginning to chase or phone people, which limited my opportunities in getting positive responses. At the same time, I was relatively satisfied during the fieldwork with how the recruitment developed, as I was finding myself busy all the time processing ethnographic data, examining literature and trying to build my story around the data. As the fieldwork year was not only a year of collecting data but learning a new methodology, my time was precious. This might have downplayed my motivation to collect more data. It was hard to step away from the research and see it as work, as the data kept coming in and I was intrigued with what I was presented. Nevertheless, I struggled sometimes with my ethnographic approach as it demanded flexibility in my thinking; having to switch between different people and settings. I was sometimes uncertain about how the research would develop and if it was going into the right direction.

Another difficulty emerged during the writing up stage of my PhD. Although my 'tracing' methodology involves the exposure of actor-networks, I nevertheless had to ensure that my informants remained anonymous. At the same time, some of my informants wanted to know what content of the interviews I would use to publish. This resulted in some informants asking me to delete sensitive data, as the information could unwillingly expose their identity. I therefore had to adapt some of my research findings to protect the anonymity of my research informants. This shows how my research has been shaped by the actor-networks it tried to expose.

**Table 2.1: List of people interviewed (not in chronological order).**

Interview list	Respondent
Livestock industry organisations	<ul style="list-style-type: none"> <li>• Livestock industry organisation 1 (Male, 50-65)</li> <li>• Livestock industry organisation 2 (Male, 40-55)</li> <li>• Livestock industry organisation 3 (Male, 50-65)</li> <li>• Livestock industry organisation 4 (Male, 50-65)</li> <li>•</li> </ul>
Dairy processors	<ul style="list-style-type: none"> <li>• Dairy processor 1 (Male, 35-50)</li> <li>• Dairy processor 2 (Male, 35-50)</li> <li>•</li> </ul>
Retailer	<ul style="list-style-type: none"> <li>• Retailer 1 (Male, 50-65)</li> <li>• Retailer 2 (Male, 35-50)</li> <li>•</li> </ul>
Pharmaceutical companies	<ul style="list-style-type: none"> <li>• Pharmaceutical company 1 (Male, 50-65)</li> <li>• Pharmaceutical company 2 (Male 50-65)</li> <li>•</li> </ul>
Veterinary surgeons	<p><u>Veterinary practice 1 North West/Wales</u></p> <ul style="list-style-type: none"> <li>• Veterinary surgeon 1 /researcher university of Liverpool, North West/Wales (Male, age 35-50)</li> <li>• Veterinary surgeon 2 North West/ Wales (Female 35-50)</li> <li>• Veterinary surgeon 3 North West/Wales (Female Partner, 35-50)</li> <li>• Veterinary surgeon 4 North West/Wales (Male, Partner, 50-65)</li> </ul> <p><u>Veterinary practice 2 North West</u></p> <ul style="list-style-type: none"> <li>• Veterinary surgeon 5 North West (Male, 35-50)</li> </ul> <p><u>Veterinary practice: 3 North West</u></p> <ul style="list-style-type: none"> <li>• Veterinary surgeon 6 (Male, partner 50-65)</li> <li>• Veterinary surgeon 7(Male partner, 35-50)</li> <li>• Veterinary surgeon 8(Male, partner 35-50)</li> <li>• Veterinary surgeon 9(Male partner, 35-50)</li> <li>• Veterinary surgeon 10(Male, 35-50)</li> <li>• Veterinary surgeon 11(Male, 35-50)</li> <li>• Veterinary surgeon 12(Male, 25-35)</li> <li>• Veterinary surgeon 13(Male, 25-35)</li> <li>• Veterinary surgeon 14 (female, 25-35)</li> <li>• Veterinary surgeon 15 (Male, partner 50-65)</li> </ul> <p><u>Veterinary practice 4: South</u></p> <ul style="list-style-type: none"> <li>• Veterinary surgeon 16 (Male, partner 35-50)</li> </ul> <p><u>Veterinary surgeons University of Liverpool</u></p> <ul style="list-style-type: none"> <li>• Veterinary surgeon/researcher 17(Female, 25-35)</li> <li>• Veterinary surgeon/researcher 18 (Male, 25-35)</li> <li>• Veterinary surgeon/researcher 19 (Male 45-60)</li> </ul> <p><u>Veterinary consultants</u></p> <ul style="list-style-type: none"> <li>• Veterinary surgeon 20 (Male, age 35-45)</li> <li>• Veterinary surgeon 21 (Male, age 35-45)</li> </ul>
Farmers	<ul style="list-style-type: none"> <li>• Farmer 1 midlands (Male, 45-50)</li> <li>• Farmer 2 midlands (Male, 45-55)</li> <li>• Farmer 3 South (Male, 45-55)</li> </ul>
Retailer farmer meetings	<p><u>Retailer-Farmer meeting Aberdeen</u></p> <p><u>Retailer-Farmer meeting Ardingly</u></p> <p><u>Retailer-Farmer meeting Cannington</u></p> <p><u>Retailer-Farmer meeting Devon</u></p> <p><u>Retailer-Farmer meeting Lanarkshire</u></p> <p><u>Retailer-Farmer meeting Neston</u></p> <p><u>Retailer-Farmer meeting Nottingham</u></p> <p><u>Retailer-Farmer meeting Preston</u></p> <p><u>Retailer-Farmer meeting Shropshire</u></p> <p><u>Retailer-Farmer meeting Usk</u></p>
Retailer focus groups	<p><u>Retailer focus group 1 North West Derbyshire</u></p>

	<ul style="list-style-type: none"><li>• Farmer (Male, 45-50)</li><li>• Farmer (Male, 45-55)</li><li>• Farmer (Male, 50-65)</li><li>• Farmer (Female, 45-55)</li><li>• Farmer (Female, 45-5)</li></ul>
	<p><b><u>Retailer focus group 2 North West Cheshire</u></b></p> <ul style="list-style-type: none"><li>• Farmer (Male, 45-50)</li><li>• Herdsman (Male, 25-35)</li><li>• Farmer (Male, 50-65)</li><li>• Farmer (Female, 45-55)</li><li>• Farmer (Female, 50-65)</li></ul>

## **Chapter 3**

Comparing the historical risk governance of agricultural antibiotic use between the UK and Sweden

### 3.1 Introduction

The purpose of this Chapter is to introduce how two different countries, the UK and Sweden, have come to formulate and regulate AB-use in agriculture since the 1950s. I have chosen the UK and Sweden to compare as the UK was the first country in the world that produced a scientific report on the public health risks of agricultural AB-use, and Sweden was the first country in the world that produced legislation on the growth promotor use of ABs. Sheila Jasanoff's (2004, 2005) concepts of 'co-production' and 'political cultures' will be used to explore how both countries responded to controversies that emerged on the risks of AB-use in agriculture. It will be argued how both countries used different styles of scientific reasoning and justification, due to the different dynamics between policy, science and publics. This co-produced different risk classifications and patterns of agricultural AB-use.

The period in the UK between the 1950s-1990s can be characterised as a political culture governed by 'expert committees' (Jasanoff, 2005a, p. 102). The government maintained (and still does) a strong relationship with science and scientific expert committees in the governance of risks. These expert committees are presented as providing independent and impartial advice to the government on the basis of evidence and means that they enjoy a widely respected status of 'character, experience and expertise' through which they gained public credibility (Jasanoff 1997, p. 228). The UK government uses these expert committees to settle scientific controversies and to act on behalf of the public under the imperative of public safety. Sweden on the other hand is not only characterised by State interventionism, but also by a 'consensus-oriented' political culture, bridging State and private actors (Bostrom & Klintman, 2006). Scientific controversies are managed outside the traditional science-policy arena. Instead of identifiable scientific experts being used as the (only) powerful actors to formulate and steer risk policies, as in the UK's expert committees, the Swedish agricultural decision-making process involved wider public participation (Saifi, 2004). This produced a more open approach towards the governance of the risks related to agricultural AB-use.

The Chapter starts by exploring the agricultural contexts of both countries and how ABs as both therapeutics and economic tools emerged in relation to the modernisation of agriculture. With the goal of maximising food production, agriculture and its modern techniques were used as a means to improve both countries' economic position in return for cheap and abundant food. As such, agricultural ABs in both countries became legitimised in a 'productivist' framework. When scientific controversies about the economic use of antibiotics in livestock unsettled their use in the 1960s, the UK Swann expert committee was established in 1969. However, they presented inconclusive results on the public health risks of ABs used in food animals. This allowed the UK's political culture to downplay the public health risks thus enabling their continued use until the end of the 1990s. By contrast, Sweden's consensus-



oriented political culture led several scientific and non-scientific discourses to enter the debate, which led to a different risk management of agricultural ABs. The discussion explores what can be learned from understanding the impact of a country's political culture on risk policies and the implications of this for future policy on agricultural AB-use.

The documents used for this Chapter involve primary and secondary sources between 1950-1990 based on the following search terms: 'The Swann Report', 'livestock antibiotics', 'antimicrobial growth promoters', 'antibiotic resistance', 'intensive farming', 'factory farms' and 'animal welfare'. Primary sources included European, UK and Swedish policy documents, UK newspaper articles of 'The Daily Mail' and 'The Times' and the UK veterinary journal 'Veterinary Record'. Secondary sources included scientific journals and books that discussed one or more of the former search terms. Following the methodology of a discourse analysis, attention was paid to what was said by whom in order to capture the co-producing effects of discourses and identities. This allowed an examination of how agricultural ABs in both countries became institutionalised through the interplay between scientific knowledges, expert committees, politics and public knowledges.

### 3.2. 1940s-1950s: Post-war agriculture and antibiotics

At the beginning of the 20<sup>th</sup> century, with just around 10% of the British population employed in the agricultural sector, agriculture in the UK was of little economic and public interest (Self & Storing, 1963). By contrast, Swedish society was characterized as agrarian, with two thirds of the Swedish population working in small family farms responsible for supplying the needs of local communities (Morell, 2011). Agricultural values were largely absent in the UK, while Sweden had a strong identification with nature. This differences in terms of the value of agriculture, influenced the way in which agricultural AB-use became problematized after the Second World War (Saifi & Drake, 2008). Europe experienced the benefits of industrialization which enabled agricultural economies to flourish. After years of food shortage, political goals were set, on the one hand, to maximise agricultural output for economic purposes and, on the other hand, to guarantee the general public an era of food security (Grant, 2005). The UK saw agriculture as a mechanism by which the national economy could be restored and its international trade position strengthened (Grant, 2005; Self & Storing, 1963). The Swedish government wanted to make its agricultural sector more rational and efficient, to transform its mostly rural society into a modern society (Flygare & Isacson, 2011; Martiin, 2015). The responsible agricultural government departments, the Ministry of Agriculture, Fisheries and Food (MAFF) in the UK and the Ministry of Agriculture in Sweden, became heavily involved with regulating agriculture during the 1950s-1970s (Murdoch & Ward, 1997; Saifi & Drake,

2008). To guarantee the stability of agricultural markets and agricultural prices, both countries set up agricultural price setting schemes that involved annual negotiations between state representatives and farmers to fix prices of agricultural products (Cox et al., 1986; Martiin, 2015). In the UK, this was a decision-making process between the UK government and agricultural stakeholders. In Sweden, however, consumers were involved in the price setting schemes of agricultural products, which represented an important part of their post-war agricultural politics (Martiin 2015). Productivistic mentalities in both countries towards modern agriculture started to take shape between the 1950s-1970s: farms, farmers and their representatives all became part of the economic construction of the agricultural sector, in which the agricultural community became convinced that efficient and maximum food production could only be ensured when farming was industrialized (Murdoch & Ward, 1997; Saifi, 2004).

The modernization of agriculture not only produced new relations between the government, farmer unions and society, but increased market opportunities for various scientific technologies that improved animal husbandry systems, including agricultural ABs. Agricultural ABs were introduced as therapeutics in both countries by the end of the 1940s to treat sick food animals (Kahn, 2016). In the beginning of the 1950s, it was discovered in the United States that when ABs were fed in low doses to food animals, these animals showed improved growth, food conversion ratios, and reproductive performance; so-called Antibiotic Growth Promoters (AGPs) (Soulsby, 2007). In the decade that followed, AB-use in food animals took on new purposes, quickly establishing them as standard, not only for the treatment of disease, but to prevent disease and as AGPs. The use of ABs as growth promoters acquired special attention as they could be used as economic tools to support livestock production systems (Kahn, 2016). In addition, as AGPs they did not require a veterinary prescription (Barton, 2000). Importantly, there was no European legislation at that time and each member state approved its own regulations about AGP use (Castanon, 2007).

The Post War modern agricultural landscape, and its close relation with science as a means to industrialize agricultural husbandry, allowed for the stabilization of agricultural ABs as both therapeutic (including preventative use) and as economic tools in the use of animals in food production. The use of chemicals in agriculture was also seen by both countries as an opportunity to improve and expand animal husbandry systems (Grant, 2005; Martiin, 2015). This initially legitimated the uncontrolled use of agricultural ABs. Strong relations developed between agricultural ministries and farmer unions with a strong interest in managing the agricultural market-place together. However, the UK excluded public debates from the political scene, while Sweden made agricultural issues part of wider societal debates.

Importantly, the high value placed in Sweden on nature, combined with concerns about the impact of agricultural techniques on environmental and public health, raised its profile in Swedish political debates (Vail, Hasund, & Drake, 1994). Moreover, the public participation model of Sweden allowed these concerns to infiltrate scientific risk debates that concerned modern agriculture. The former differences in governmental models, consumer positions and public values regarding the governance of intensive farming influenced how both countries would receive the first scientific report on agricultural ABs and further problematize the issue.

### 3.3 Controversies in the 1960s: The de-stabilisation of agricultural antibiotic-use

#### 3.3.1 The UK: agricultural antibiotic controversies and the role of 'expert committees'

In the 1960s, after agricultural ABs were commonly used as economic and therapeutic tools, the first scientific evidence on resistant bacteria in food animals was reported (Randall 1969). At the same time, animal welfare concerns from consumers started to raise questions about modern agriculture (Food for the table – food for thought 1964). The UK's political culture of establishing expert committees to settle discussions played an important role in how agricultural AB-use was to become framed and regulated. In the UK, the problematisation of intensive farming practices and 'animal welfare' at the beginning of the 1960s can be seen as one of the first 'expert' discourses in which AB-use was considered and 'co-produced' by science and the UK government. A key event in the UK at this time was the publication of animal welfare activist Ruth Harrison's book 'Animal Machines' in 1964, in which she described the moral and ethical dimensions of intensive poultry and livestock farming. Intensive livestock farms became framed as 'factory farms', referring to the automated practices and detrimental livestock conditions. The book initiated extensive public debate and led to mass demonstrations in London that condemned the 'cruel' modern farming methods (Winter, 1964). However, the agricultural industry and farmer communities responded stating that Harrison presented an unfair picture of farming to the public ("Food for the table - food for thought," 1964) The National Farmers Union (NFU) condemned the book as a 'false picture of British agriculture', and the Poultry and Egg Producers' Association described its comments on intensive egg and poultry production as a 'slur on production' (Winter 1964). In the media, the response to Harrison's condemnation of intensive farming practices was dismissed as 'emotional reasoning' ("Food for the table - food for thought," 1964)

However, in 1965, in response to the public outcry on Harrison's book, the government had to intervene to settle the controversies and to restore public trust in agricultural practices. They appointed an expert committee chaired by Professor Roger Brambell, who produced the 'Report of the Technical Committee to Enquire into the Welfare of Animals Kept Under Intensive Livestock Husbandry Systems', which became known as 'The Brambell Report' (1965). Importantly, the UK's political culture had a tendency to use scientific expert committees to explore matters 'technically'. These expert committees enjoyed a widely respected status of 'character, experience and expertise' through which they gained public credibility (Jasanoff 1997, p. 228). The Brambell report concluded, surprisingly, that in the absence of scientific evidence to measure animal welfare, the ethical dimensions of animal's feelings should be taken into account when making decisions on agricultural intensive systems (Brambell, 1965; Woods, 2012). However, the Brambell report (1965) also encouraged the 'progressive state' of intensive agricultural systems and claimed that in relation to housing standards and the continuation of AB-use in livestock: 'the effects are more likely to be beneficial than adverse' (Brambell, 1965, p. 14). Although tensions between scientific and ethical perspectives on animal welfare still remain unresolved (Woods, 2012), the Brambell report supported the continuation of intensive livestock practices and within this the use of ABs (Brambell, 1965).

At the same time, international scientists were reporting bacteria with drug resistance in both humans and animals and in the UK, questions were raised as to whether this could be related to the practice of AB feeding in farm animals. The matter had been examined before the publication of Brambell report by a joint expert committee under the chairmanship of Lord Netherthorpe in 1960 (Randall, 1969). Their report concluded in 1962 that the situation should be further explored, but reasserted there was no human health risk. The economic benefits of AGPs were re-emphasised and the committee advised continued feeding of AGPs to food animals (Randall, 1969). As such, the expert committees (Netherthorpe, Brambell), used by the UK government to settle public controversies, were in fact co-producing the continued legitimisation of agricultural AB-use.

In the years that followed, new scientific counterclaims on the relationship between drug resistance, food safety and AGP-use were made by vets (Anderson & Path, 1968; Smith, 1968). Moreover, veterinary scientists Anderson and Path (1968) believed that intensive animal husbandry systems and practices provided opportunities for resistant bacteria to develop and spread, and they questioned the economic purpose of farm ABs. Public anxiety was also starting to rise about the effects of chemicals on health, such as DDT, insecticides and on 'things that may find their way into our food' ("Rapid action on livestock antibiotics,"

1969). As a result, the economic purpose of farm ABs continued to be questioned or 'destabilised' by competing scientific, political and public discourses.

In response to these growing concerns another expert committee was established to address these scientific and public concerns – the Swann committee – who published their recommendations in the Swann Report in 1969. The remit of the committee was to discuss the control of AGPs (ABs distributed without veterinary prescription to serve economic purposes) and the control of therapeutic ABs (ABs needing veterinary prescription and which served medicinal purposes) (Randall, 1969). An area of particular interest for the Swann Committee (1969) was to identify AGPs which would be of economic benefit to the UK, but would not impact on the efficacy of therapeutic drugs for humans by developing AMR. The Swann report (1969) concluded that agricultural AB-use in general could pose a hazard to human and animal health as it could stimulate the development of resistant bacterial strains. However, it also recognised the economic importance of AGP-use. It advised AB-use in animals should not to be used as growth promoters and suggested further exploration and monitoring of the issue by setting up yet another independent scientific committee (which would not happen until the late 1990s).

Swann (1969) recommended that agricultural ABs should be divided into two risk categories: 'feed' ABs (AGPs) that would be available without prescription and 'therapeutic' ABs that would only be available by veterinary prescription. The preventative use of ABs was considered less important. The shift in framing AGPs as 'feed' ABs can be seen as a tactical move; it downgraded the risk of AGPs into a 'harmless' food additive. The risk classification was supported by the veterinary community in the UK who believed it was the higher dosages of therapeutics that led to AMR and not the sub therapeutic dosages of AGPs (Kahn, 2016). In effect, the Swann report approved continuation of economic agricultural AB-use and co-produced the use of farm ABs. The UK consumer was used to matters that concerned public safety being handed over to scientific expert committees who would inform the UK government (Jasanoff, 1997). Although several UK consumer organisations existed at that time, they were not unified and did not therefore act as a co-operative pressure-group in support of consumer interests (Tivey, 1968). The absence of a strong consumer movement limited the opportunity for consumers to participate in food policies. This is despite, the Chairman of the public group the 'Farm and Food Society' stating that: 'there is now a mounting pile of evidence to show that "factory farming methods", which over the last decade have made rapid advance with the full support of successive Governments and of the National Farmers Union (NFU) hold health hazards for the consumer' ("Better Farming or Self-Betterment? 'Factory' Farming Under Attack," 1970).

The UK government represented the interests of the consumers through the advice of expert committees, which kept issues related to food risks as a private dispute between policy actors and scientists (Jasanoff, 2005a; Phillips, 2003; Wales, Harvey, & Warde, 2006). Against this political culture of science-centred approaches towards food risks and lack of public engagement, the risk classification of agricultural ABs into feed and therapeutic ABs became established and the risks were diverted from the public radar.

### 3.3.2 Sweden: the democratic formulation of the risks of agricultural antibiotic use

Sweden's strong environmental values and its political culture of consensus-oriented regulation of environmental and public health risks co-produced a different 'space' for the debate about agricultural ABs. During the 1960s – 1970s, Sweden's agricultural landscape underwent massive change (Saifi, 2004). As with the UK, the Swedish agricultural model was characterised by State interventionism to modernise agriculture (Flygare & Isacson, 2011). Although the Swedish public held the Swedish State ultimately responsible for a clean environment and a healthy society, environmental and agricultural policies were developed through democratic debate between science, State and consumers (Bostrom & Klintman, 2006; Vail et al., 1994). When scientific controversies about the environment and agricultural practices emerged, consumer organisations were invited to participate in discussions by policymakers. This resulted in policies that were agreed upon by scientific and non-scientific groups (Vail et al. 1994).

When Rachel Carlson's book *Silent Spring* was published in 1962 in Sweden, it led to public discussions about the environmental effects of modern agricultural practices (Flygare and Isacson 2011). Public concerns were raised about chemical use and toxic substances entering the environment that could lead to adverse effects (Vail et al., 1994). Swedish animal production had a long tradition of controlling infectious diseases in livestock (Wierup, 2001a), but vets were concerned that ABs were increasingly being used to cover up poor animal husbandry practices (Kahn, 2016). This prompted vets to question the dependency of Swedish agriculture on industrial techniques. After the publication of the Swann report, Swedish vets were one of the first groups to raise concerns about AGPs. Swedish farmers, who were dependent on the internal market, worried about the loss of trust by consumers in their products and also started to question the use of AGPs (Kahn, 2016). When scientific evidence was published raising questions about the growth-promoting effects of AGPs on calves in the early 1970s, it led the calf and beef production industry to voluntarily end the use of AGP (Wierup, 2001a). In a public letter, the Swedish Farmer Association (LRF) promised the restrictive and

careful use of ABs (Edqvist & Pedersen, 2002). Moreover, the LRF itself requested that the Swedish government ban the use of AGPs in food animals. The Swedish Board of Agriculture reassessed the case but drew similar conclusions to the recommendations in the Swann report and advised the continued use of AGPs. No consensus was reached between science, State, farmers and consumers on how to regulate AGPs and the controversies in Sweden on AGP-use in food animals continued. To maintain the trust of consumers and to limit the development of resistant bacteria, farmers themselves proposed that ABs should only be used under veterinary control (Edqvist & Pedersen, 2002).

In 1981, a series of newspaper articles in *Dagens Nyheter* (Daily News) reported that more than 30 tons of ABs were used in feed animals for growth promotion each year (Cogliani et al., 2011). Swedish consumers were outraged and a consumer report in Sweden in 1984 showed that consumer faith in meat had dropped significantly, which prompted farmers to produce food without the use of drugs (Cogliani et al., 2011). As scientific uncertainty continued, both consumer organisations and the LRF asked for mandatory policy measures to control the use of ABs (SOU, 1997). The Swedish consensus-oriented political culture took both scientific and public knowledges seriously resulting in the 1986 *Feeding Stuff Act*, which banned the use of AGPs in agriculture (SOU, 1997). Despite this, concerns about the regulation of preventative and therapeutic use of agricultural ABs in Sweden continued to grow and this further impacted on the risk classification and use of agricultural ABs (Grave et al., 2006). The Swann report in Sweden raised more concerns than it answered. While it resulted in further research, this reached similar conclusions to the Swann committee. As science in the political culture of Sweden fulfilled a democratic role instead of a determining role, the debate remained open and as such, the risks of economic and therapeutic use of agricultural ABs were constructed as a concerning societal issue. This was in contrast to the UK's exclusive reliance on expert committees to inform and frame the risks about agricultural AB-use. The Swedish 1986 *Feeding Stuff Act*, which banned AGP-use in agriculture, made Sweden the first country to build an economically viable agricultural system without using ABs to compensate for poor management and low housing standards (Wierup, 2001a).

## 3.4 1970's-1990's: The re-stabilisation of agricultural antibiotic use

### 3.4.1 The UK: re-classifying agricultural antibiotics as economic and therapeutic tools

Following the publication of the Swann report in the UK, an article in the *Financial Times* responded with the message that ‘the case against antibiotic feeding has not been fully proved by any means. It could be said to be as much instinctive as factual’ (Cherrington, 1969). The scientific uncertainties of the report became a focus of protests from farmers and the pharmaceutical industry in 1970 who feared the consequences of limited AB-use in food animals (Fishlock, 1970; Reeves, 1970). Farmers feared additional costs would be accrued were the recommendations to be implemented and protested that small providers would be forced out of business (Williams-Smith, 1970). Although many politicians supported the report, a House of Commons (1969) meeting discussed the danger of economic losses due to feed additive stocks, effects upon husbandry systems and the extra costs of food production. This only became more intensified by the growing influence of Europe.

When the UK joined the EEC and the Common Agricultural Policy (CAP) in 1975, it had to engage with Europe’s agricultural focus on maximum food production and food security, which further incentivised the intensification of animal husbandry systems (Grant, 2005). Europe followed Swann’s recommendations of dividing farm ABs into two categories: feed ABs and therapeutic ABs (Castanon, 2007). British policy makers did not set up an independent committee to explore the AGP issue further and when Margaret Thatcher came into power 1979, her deregulatory agricultural ambitions and disinterest in farming led to a dilution of the Swann Report’s recommendations (Edqvist & Pedersen, 2002). In the decades that followed, several scientists (Dutta & Devries, 1984; Levy, FitzGerald, & Maccone, 1976; Linton, 1977; Threlfall, Rowe, & Ward, 1978) reported evidence of the transfer of multidrug resistant bacteria between humans and animals. However, in the absence of sufficient scientific evidence that the AGPs in use could pose a danger to animals, humans or the environment, they were allowed to be used (Castanon, 2007).

The potential risks of therapeutic ABs used in food animals, raised in the Swann report, became largely ignored up until the 1990s (Barton, 2000). What becomes clear is that the political cultures of Europe and the UK treated the absence of conclusive evidence produced by expert committees on the link between the agricultural use of AGPs and AMR in humans as the absence of immediate risk. The media and consumers lost interest after Swann, which



kept further scientific scrutiny at a distance. It enabled at the same time for parts of the Swann's report to become aligned with governmental economic interest and the productivist mentality of the agricultural lobby. The perceived absence of human health risks associated with AGPs resulted in a re-stabilisation of ABs in Europe and the UK turning them into economic and therapeutic tools. The debate was effectively silenced until 1990s (Edqvist & Pederson, 2002).

#### 3.4.2 Sweden: re-classifying agricultural antibiotics as therapeutics only

Pushed by a strong environmental lobby, Swedish policymakers developed new goals during the 1980s to limit the environmental impact of mainstream agriculture, to stimulate local food production and to support organic farming (Flygare & Isacson, 2011). Concerns were not restricted to politicians, farmers and consumers anymore, but were echoed as well by public discourses on animal welfare during the 1980s (Vail et al., 1994). Moreover, the Swedish writer Ann Lindgren, well known for the creation of 'Pippi Longstocking', published a series of satirical stories on farm animals in leading newspapers, fuelling the animal welfare debate in Sweden (Lohr, 1988). A new *Animal Welfare Act* was passed in 1988 which was aimed at preventing animal diseases through high production standards on farms: Sweden was the first country in the world in which farm animals received rights (Ministry of Agriculture Food and Fisheries Sweden, 1998). As earlier discussed, the UK government framed the animal welfare debate as a technical debate, which led to some technical modifications to improve housing systems but animal husbandry systems continued to be intensified (Woods, 2012). The animal welfare debate in Sweden however was not silenced or dominated by science; it became a topic that involved a wide range of both technical and ethical discussions that questioned animal husbandry systems and their production techniques (SOU, 1997). In contrast to the UK, animal welfare established itself as an important pillar in agricultural debates and pushed farmers and vets to adjust their practices in favour of animal welfare (LRF, 2016). After the ban of AGPs in 1986, agricultural ABs became classified as therapeutic veterinary medicines only and had to be dispensed through pharmacies, supplied by drug wholesalers or manufacturers (Wierup, 2001a). Vets were not permitted to own a pharmacy or sell medicines for profit (Wierup, 2001a). The ban of AGP-use, concerns about AMR, therapeutic agricultural AB-use prescribed by vets only, the new focus by the public on agricultural sustainability and the flaws of animal husbandry systems resulted in Swedish farmers searching for alternatives. For farmers to produce both economically and ecologically responsible products without the use of ABs, investments in animal environment and management became essential (Ministry of Agriculture Food and Fisheries Sweden, 1998).

In the years that followed, actions were not only taken to limit the public health risks from feed ABs, but also to abolish prophylactic use and limit therapeutic uses of farm ABs. In

addition, the Swedish National Veterinary Institute (NVI) started to collect scientific facts and statistics on antimicrobial use in farm animals during the 1980's (SVARM 2000). The NVI wanted to know how and to what extent antimicrobials were used in livestock animals order to analyse trends in resistance. This analysis was however limited at that time by the fact that the amounts used could not be directly assigned yet to specific species of animals (SVARM 2000). The NVI furthermore undertook 'problem-orientated' research to limit further AB-use (Cogliani et al., 2011; Ministry of Agriculture Food and Fisheries Sweden, 1998). The Swedish approach to controlling infectious diseases in livestock led to the incorporation of preventive methods such as improved biosecurity, improved housing, more use of vaccines and vector control, better diagnostics including testing for sensitivity to antimicrobials (Wierup, 2001a). These measures, together with more effective use of ABs, lowered agricultural AB-use significantly in the decades that followed.

Swedish consensus-oriented policy culture framed the risks of agricultural ABs differently within a wider debate on the future intensive animal husbandry systems. As Sweden's political culture was characterised by consensus through a clear separation of interests, it did not solely rely on scientists to inform their decision-making process (Asdal & Gradmann, 2014). The scientific uncertainty on the risks of AGPs and AB-use in general forced Sweden to explore the topic further and eventually ban AGPs and restrict AB-use to avoid potential public health risks. Societal pressure on different fronts, such as consumer pressure, farmer concerns, animal welfare, sustainability discourses, contributed to the scientific governance of agricultural AB-use (Edqvist & Pedersen, 2002).

### 3.5 1990s: Consumer power, new scientific evidence, and European decision-making

During the late 1980s-1990s, environmental and agricultural sustainability discourses emerged that created more public awareness of food safety and food quality in Europe (Grant, 2005). The BSE crisis in the UK during the 1980s-1990s proved to be a critical event as the UK public lost trust in expert authorities and blamed UK authorities for 'not being transparent and accountable' (Jasanoff, 2005a, p. 111). The public demanded that agricultural decision-making was made more accessible 'beyond the farming unions and agricultural officials' (Phillips, 2003, p. 24). The UK political culture started to experience a shift in the 1990s towards a style of governance which included public discussions and political transparency on risks posed by science and its technologies (Irwin, 2006). At the same time, new evidence of vancomycin-resistant enterococci (VRE) in human hospitals and in livestock farms during the early 1990s

raised international concerns (Klare et al., 1999). It was suggested that the long term use of avoparcin as growth promotor had resulted in selection of VRE in these animals, which was transferred to humans via the food chain (Klare et al., 1999). Subsequently, attention was raised on the possible transfer of AB-resistant bacteria from the food chain to the human population (Barton 2000). Growth promotor use in animals became widely discussed as further research found antibiotic resistance in other animal and human enteric bacteria, such as *Campylobacter*, *E. coli*, enterococci and *Salmonella* Typhimurium DT104 (Barton, 2000).

Nevertheless, when Sweden entered the European Union in 1995, the European Union initially asked Sweden to provide scientific underpinnings that supported their ban in growth promotor use (Wierup, 2001a). But other Nordic countries and Denmark started to ban avoparcine and other growth promotors as well in 1995. Further scientific uncertainty on the issue and consumer and political concerns of the Copenhagen recommendations of 1998 to the 'Precautionary Principle' on growth promotor use in agriculture, banning growth promotors such as tylosin, spiramycin, virginiamycin, and bacitracine (Casewell et.al 2003). The economic properties of AGPs which had made them so popular became a weapon used against them. AGP's were 'misused' and 'overused' *because of* their economic properties.

Concerns about the 'misuse and overuse' of livestock AB-use as public health risk started to enter political and public debates. The WHO (1997, p.17) recommended to review national practices of prudent use of antimicrobials in animals with a focus on surveillance, enforcement programmes, education strategies, and prescription and use. More scientific committees, both in Europe and the UK, were set up by the end of the 1990s to further evaluate AB-use and AMR both in humans and animals (Barton, 2000). The EU started to phase out AGP-use, leading to a complete ban of AGP's in 2006 (Soulsby, 2007). However, the prophylactic and therapeutic agricultural AB would continue to remain largely unregulated at European and in the UK for the decade that followed.

This is in contrast with Sweden, who banned prophylactic use and implemented strategies to further reduce therapeutic use. In line with Sweden's political culture, AB strategies, antimicrobial guidelines, biosecurity, disease-control programmes, and optimised management and husbandry are continuously negotiated between the different parties (EMA, 2016). The Swedish government set up mandatory evaluation of farm building plans, and developed mandatory and voluntary disease control programmes which have economic incentives for the farmer. The latest European Medicine Agency Report (2016) on AB sales for food-producing animals in 2013 showed that the population-corrected unit (PCU) sales in tonnes of active ingredient was 422 tonnes in the United Kingdom compared to 10 tonnes in Sweden. Differences in epidemiological profiles between countries of bacteria and AMR in

humans and animals have been identified as well the in latest public health reports of both the UK and Sweden (Public Health England, 2014; Swedres-Svarm, 2015).

### 3.6 Discussion

This Chapter has discussed how the political cultures of the UK and Sweden *mattered* in the governance of livestock AB-use as public health risk. How both countries used science to inform debates has been central in order to examine how this shaped natural and social orders of livestock AB-use and AMR as public problem. As discussed, the UK's political culture heavily relied on scientific experts to inform livestock AB debates, steering 'evidence-based' policies. But building interventions upon a frame that is solely informed by scientific experts poses however two problems. First, science in itself does not hold an overarching truth about the problem it tries to describe and capture (Latour, 2005). When science tries to organise a problem, it inevitably ignores other types of lay knowledges (Jasanoff, 2016). However, scientific knowledge is just one representation of a problem amongst many other possible states of knowledges. This becomes clear in the Swedish case, as they incorporated consumers, vets and farmers aside science to inform the debate. By bringing in competing risk interpretations instead of avoiding them, this allowed for a reflexive and open examination of the presented scientific evidence itself (Wynne, 1992). Sweden embraced as such the complexity of the problem, addressing the environmental, animal welfare, and public concerns as a whole.

At the same time, this Chapter has shown how the production of scientific knowledge and its applications are far from an objective process. In the UK, science has played an ambiguous role in the governance of livestock ABs. Although veterinary scientists initially questioned the legitimacy of using livestockfarm ABs as AGPs, the immediate risks of both AGPs and therapeutic ABs were downplayed by scientific expert committees (Brambell, Netherthorpe and Swann) and the UK government, resulting in the continuation of their use. Within this political system in which consumers accepted the privileging of science over beliefs, advice from expert committees on farm ABs became constructed as 'matters of fact' instead of sites of controversy (Latour, 1987). Hence, the UK government, experts and consumers did not act in isolation; they co-produced the silent UK consumer. This enabled continuation of both economic and therapeutic use of agricultural ABs up until the late 1990s, when national food crises constructed a new type of consumer and institutional reform.

In contrast, in Sweden's consensus-oriented political culture, the Swedish political culture proved to be reflective and pragmatic in its interpretation and use of scientific evidence. Scientific evidence was negotiated before risk policies were established. Absence of conclusive scientific evidence was seen in Sweden as a possibility of risk and the use of

agricultural ABs for economic purposes in food animals became a serious issue. A consensus-oriented debate between scientific knowledges and non-scientific knowledges on agricultural AB-use and intensive farming enabled a broader scope of what was at stake and what needed to be done. With the Swedish economy being dependent upon their internal market, the will of consumers 'co-produced' how science became interpreted. With agricultural markets reflecting upon what was necessary to maintain consumer trust, State interventionism was accepted and agricultural AB legislation collectively decided upon. This pushed the agricultural industry to restrict their therapeutic AB-use and to adopt new innovative techniques. This not only resulted in Sweden being today one of the lowest users of livestock AB-use across Europe, but having at the same time high quality animal husbandry and welfare standards.

The following Chapter will continue to explore how UK's political culture responded from the late 1990s onwards to the global problematisation of the 'misuse and overuse' of livestock AB-use. How livestock AB-use was made to matter, by whom, and what was at stake will be the core interests of the Chapter.

## **Chapter 4:**

Antibiotic use in the UK's livestock industry as 'matter of concern'

## 4.1 Introduction

The previous Chapter discussed how the UK's technocratic political culture used scientific expert committees in the 1950s and 1960s to examine the risks involved with livestock AB-use. It showed how scientific evidence on 'the misuse and overuse' of livestock ABs as 'matter of public health concern' was reduced, simplified and manipulated to fit both political and agricultural agendas. This Chapter continues to explore from the 1990s onwards how national and international risk narratives on livestock AB-use resulted in today's voluntary industry-led approach in the UK. Previous attempts to introduce industry led approaches failed to unite experts, governmental policymakers, and agricultural industries. This changed when the UK established the 'Review on Antimicrobial Resistance', chaired by Lord Jim O'Neill in 2014, to evaluate the global economic and social impact of AMR. The 2015 O'Neill report openly accused livestock industries across the world of the 'misuse and overuse' of ABs. The Review proposed global and national AB reduction targets in livestock industries to immediately reduce AB-use. But without legal power, the O'Neill committee first had to make livestock AB-use into a 'matter of concern' to UK governmental and agricultural policymakers.

Callon's 'sociology of translation' will be used to expose the workings of the UK's political culture. According to Callon (1986), in order for scientists to create scientific authority, they need to 'enrol' participants or 'allies' to turn resistance on a topic of concern into desirable futures. As an example, Callon (1986) used the preservation of scallops as an example of the way in which French scientists and fisherman in Saint Brieux, France came together, despite different interests, scientific and commercial, in the problem-solution 'how and if scallops anchored themselves in their early lives'. He reveals how actors who were previously unconnected can reconcile around a 'matter of concern' by sharing the same problem-solution definition or Obligatory Passage Point (OPP). The OPP reflects the way in which the different actors converge on the formulation of the issue at the same time as keeping their own interests in mind. In Callon's study, the OPP was formulated in such a way that the scientists could gain professional recognition while fisherman could increase their harvests (Callon, 1986). This first phase of translation is called *problematization*, during which the recruiting actors try to make themselves indispensable by identifying allies and design an action program or OPP. Through the *interessment* phase, which often involves texts and documents, the recruiting actors try to lock the recruited into place within the roles they have defined for them (Callon, 1986). In the *enrolment* phase, identities, goals, motivations, interests and more are negotiated. If successful, the recruited actors judge that their defined roles are better than other available options. They are now reconciled in an 'alliance'. *Mobilisation* is the final phase, during which the spokespeople who enrolled in the alliance start speaking for the many they represent

(Callon, 1986).

Importantly, only a successful cascade will allow the continuation of the alliance, not the other way around (Callon, 1986, p. 15). The alliance may at the same time at any moment fall apart, as enrolled actors may resist the roles and definitions they get attributed. The sociology of translation explores, as such, the dynamics of power and settlement during ‘knowledge-in-the-making’ around a topic of concern. It can be used in practice to evaluate how a controversy is settled into a matter of concern by bringing opponents together that share interests by aligning with the OPP. I will use the sociology of translation (1986) in this chapter to study how livestock AB-use as ‘matter of concern’ brought economic experts, governmental and agricultural policymakers together and resulted in UK’s industry-led approach. I will discuss how different interests have been consolidated in the pursuit of a common goal of responsible AB-use. This process co-produced the emergence of the UK’s agricultural organisation RUMA from the 1990s as the agricultural AMR policy lead. As will become clear, RUMA was *made* into an anti-political organisation to serve political and agricultural purposes. But policy frames have intended and unintended effects. Callon (1998) has defined this as the ‘overflows’ of frames. These overflows destabilise the standardisation of responsible medicine-use and can re-politicize livestock AB-use. The chapter will close with a discussion of the overflows of the UK’s technocratic policy frame of responsible AB-use.

## 4.2 Initial failures to establish livestock antibiotic-use as ‘matter of concern’ across sites

Although the UK Swann report (1969) concluded that livestock AB-use could pose a hazard to human and animal health, stimulating the development of resistant bacterial strains, the report failed to unite different interest groups to monitor the issue more closely in the decades that followed. In the 1990s, AB-use in both human and animal health became globally politicised with new evidence of AMR across species levels (European Union, 1998; WHO, 1997). The WHO published, in 1998, a report which argued that antimicrobials used for any condition adds to the selective pressure of micro-organisms to develop resistance.



*“The wide and increasing use of antimicrobial agents in humans and animals, and in agriculture has exerted intense pressure for microorganisms to develop resistance which is rapidly becoming a leading cause of concern for public health.” (WHO, 1998, p.3)*

The WHO report (1998, p.3) stated that trust in the ‘healing power’ of antimicrobials by both professionals and patients had resulted in the ‘overuse and misuse’ of ABs in humans and animals. Most importantly, the ‘overuse and misuse’ of ABs in humans and animals was framed as *the* main risk to the emergence of AMR. A causal claim was made between AB ‘behaviour’ and the development of AMR. The WHO (1998) urged countries to focus their risk interventions on three main pillars

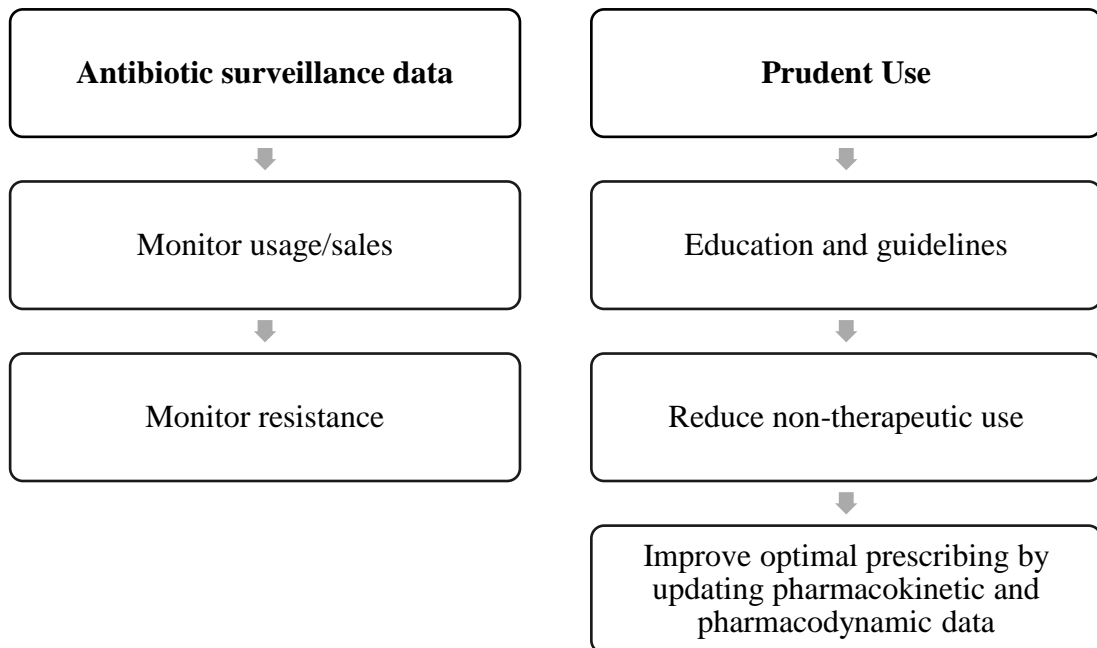
- AB surveillance strategies;
- ‘Prudent’ use through ‘behavioural’ interventions;
- Research:
  - New ABs/alternatives
  - The cost implications of resistance and of its detection

#### 4.2.1 UK 2000 AMR action plan: de-politicising antibiotic ‘overuse and misuse’

In 1998, the UK House of Lords published the ‘Path of Least Resistance’ report to inform the UK’s upcoming national action plan. The report stated that the use of ABs in animals had ‘profound influence’ on AMR development in human pathogens (Standing Medical Advisory Committee Sub-Group on Antimicrobial Resistance, 1998, p. 11). In 2000, the UK government published its first ‘Antimicrobial Resistance Strategy and Action Plan’ taking into consideration the recommendations of the Standing Medical Advisory Committee (SMAC), the recommendations of the WHO, and those of the European Conference on ‘The Microbial Threat’ in Copenhagen September 1998 (Department of Health, 2000, p. 6). The overarching two policy pillars of the Government’s strategy were (Department of Health, 2000, p. 4):

- To minimise the morbidity and mortality due to antimicrobial resistant infection
- To maintain the effectiveness of antimicrobial agents in the treatment and prevention of microbial infections in man and animals.

It involved the following ‘methods of science’, outlined in Figure 4.1, to ‘control’ livestock AB-use.



**Fig. 4.1:** Strategies to achieve prudent use in UK's 2000 Antimicrobial Resistance Strategy and Action Plan

The AB surveillance data was directed at monitoring progress (Department of Health 2000, p.6); surveillance mechanisms became constructed as trustworthy technologies that enabled the governance of irresponsible AB behaviour. The surveillance data would not only improve data and information available on antimicrobial resistant organisms and illness to monitor trends but also inform veterinary and animal husbandry practice (Department of Health, 2000, p. 8). It would furthermore support optimal prescribing policies and practice and relate data on patterns of use and antimicrobial resistance. Finally, the data had to improve the correlation of data on patterns of AB-use, antimicrobial resistant organisms and clinical problems due to them, in animals and man (Department of Health, 2000, p. 8).

Since 1998, AB data surveillance has been the responsibility of the Veterinary Medicines Directorate (VMD). The surveillance data was initially provided on a voluntary basis by the veterinary pharmaceutical companies from 1998-2004, but from 2005, this became a statutory requirement in accordance with the Directive 2001/82 of the European Parliament and of the Council of 6th November 2001 on the community code relating to veterinary medicinal products (VMD, 2007, p. 9). This resulted in the publication of annual reports of the VMD (UK-VARSS reports) that provide insights on annual veterinary sales in the UK.

To promote optimal prescribing in animals, the VMD was made responsible for providing professional education and encouraged the production of prescribing guidelines, together with the British Veterinary Association (BVA), National Farmer Union (NFU) and the National Office of Animal Health (NOAH)<sup>3</sup> with the cross-sector lobby group RUMA under NOAH's umbrella. NOAH had established RUMA in 1997 to promote 'the highest standards of food safety, animal health and animal welfare in the British livestock industry' (RUMA, n.d.). RUMA members represented interests in agriculture, veterinary practice, the animal medicines industry, farm assurance, training, retailers, consumers and animal welfare. Although RUMA was established by the industry to provide public accountability of prudent use practices in agriculture, some industry members argued that RUMA's role was the result of agricultural industry members wanting to maintain control over AB-use.

*"If you were being unkind, I heard people sort of saying that, you know, they were basically an organisation designed to maintain largely the status quo. Do the – say the right thing, but continue on as planned."* (Veterinary surgeon 20)

As will become clear in the following paragraphs, RUMA's role would be co-constructed over the years with the developing AMR issues and concerns around livestock AB-use and changing policy frameworks. But, with RUMA's limited role at the time and a lack of commitment by the agricultural sectors, there was a failure to translate policies for prudent AB-use across livestock industries into action.

*"There has always been a lack of belief within the livestock sector that antimicrobial use in animals is a significant factor in resistance in humans and that meant that people were, in essence, standing back, and saying well, "it's not us gov, we don't really need to change."* (Respondent Livestock industry organisation 1)

To reduce unnecessary and inappropriate use of ABs for non-therapeutic use in animals in the years to come, the VMD would (and still) review appropriate usage, in light of the advice from the then Advisory Committee on the Microbial Safety of Food (ACMSF) and the Veterinary Products Committee, and EU decisions (Department of Health, 2000, p. 16). To further support the regulatory framework to improve optimal antimicrobial prescribing, the VMD would critically assess products at the time of renewal of marketing authorisations to ensure product

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<sup>3</sup> NOAH was established in 1986 to replace the Animal Health Register of the Association of the British Pharmaceutical Industry, which dates back to 1955. NOAH represents the companies that research, develop, manufacture and market licensed animal medicine in the UK. The aim of NOAH is to promote the benefits of safe, effective, quality medicines for the health and welfare of all animals.

characteristic summaries were correct. In addition, the VMD would follow up recent advances in pharmacokinetic and pharmacodynamic data to update antimicrobial dose rates and strategies for authorised and new antimicrobials (Department of Health, 2000, p. 17).

However, these ‘methods of science’ focused mainly on measuring veterinary sales and educating AB-users, rather than addressing the structural problems of the UK livestock industries that resulted in AB dependency. The VMD published veterinary AB sales data between 2002-2012 (UK-VARSS, 2013; VMD, 2008) remained largely the same over the decade that followed. Table 4.1 shows the veterinary sales of ABs in the UK in the context of the livestock population, presented in sales of total antimicrobial therapeutic products by chemical grouping (tonnes active ingredient) 2002-2012.

**Table 4.1: The UK’s veterinary sales in tonnes of active ingredient of total antibiotic products by chemical grouping between 2004-2012 for Food and Non-Food Animals**

<b>Product</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>
Tetracyclines	243	240	192	174	174	177	200	110	187
Trimethoprim/ Sulphonamides	77	74	71	73	70	73	75	72	65
B-Lactams	63	60	70	72	69	76	93	86	82
Aminoglycosides	22	20	21	20	18	19	22	19	20
Macrolides	39	37	36	33	35	39	35	37	41
Fluoroquinolones	1	2	2	2	2	2	2	2	2
Other	11	12	13	14	15	16	20	20	12
<b>Total</b>	<b>454</b>	<b>446</b>	<b>405</b>	<b>387</b>	<b>384</b>	<b>402</b>	<b>447</b>	<b>346</b>	<b>409</b>

**Note:** Adapted from UK-VARSS, 2013; VMD, 2008

#### 4.2.2 The impact of international organisations and risk narratives

During the first decade of the 21st century, antimicrobial use and AMR in human and animal health remained a concern on international agendas (ECDC, 2009; FAO, OIE, & WHO, 2008; WHO, 2001). The WHO recommended six main interventions in 2001 to specifically address the use of antimicrobials in food-producing animals (WHO, 2001, p. 37): 1. the requirement for obligatory prescriptions for all antimicrobials used for disease control in food animals; 2. phasing out of the use of antimicrobial growth promoters if they were also used for treatment of humans; 3. creation of national systems to monitor antimicrobial usage in food animals; 4.

introduction of pre-licensing safety evaluation of antimicrobials with consideration of potential resistance to human drugs; 5. monitoring of resistance; 6. development of guidelines for vets to reduce overuse and misuse of antimicrobials in food animals. Europe became in 2006 the first continent to ban the use of AB growth promoters in animal feed. Furthermore, the European Medicines Agency<sup>4</sup> (EMA) launched, in September 2009, ‘The European Surveillance of Veterinary Antimicrobial Consumption’ project (ESVAC). This project has the main responsibility to collect and report, in a harmonised manner, sales of veterinary antimicrobial agents in animals from member states to assess veterinary prescribing patterns over time (EMA, 2011). The first ESVAC report was published in 2011, in which eight European countries had provided veterinary sales surveillance data for 2005-2009 (EMA, 2011). The report showed how veterinary sales surveillance data across the eight countries, estimated in PCU<sup>5</sup> (in 1000 tonnes) of the animal population only decreased by 3.1 % (See Table. 4.2). Other major findings of the report were the substantial differences in veterinary prescribing of antimicrobials between countries and differences in sales (EMA, 2011, p. 6).

**Table 4.2: Estimated PCU (in 1,000 tonnes) of the population of food-producing species by European country for the years 2005-2009.**

Country	2005	2006	2007	2008	2009
Czech Republic	888	887	875	840	771
Denmark	2443	2543	2537	2523	2447
Finland	562	558	554	541	524
France	7801	7666	7789	7707	7539
Netherlands	3170	3214	3288	3133	3109
Norway	436	437	429	438	440
Sweden	837	828	819	819	825
Switzerland	-	729	731	734	743
United Kingdom	6142	6190	6202	6018	5925
<b>Total</b>	<b>22280</b>	<b>23052</b>	<b>23224</b>	<b>22754</b>	<b>22322</b>

**Note:** Adapted from the first ESVAC report from the European Medicines Agency (2011)

<sup>4</sup> The European Medicines Agency is a decentralised body of the European Union responsible for the evaluating and supervision of medicines for human and veterinary use.

<sup>5</sup> PCU is the measurement standard set by the ESVAC (European Surveillance of Veterinary Antimicrobial Consumption). The calculation standard estimates the weight of the animal (or group) at the time of receiving an antibiotic. The unit is now used across EU Member States and is an approximation of consumption, extrapolated from sales data (VMD 2018).

With the burden of infections increasing due to multi-drug resistant bacteria in humans across Europe, AMR turned into a even higher-profile problem from 2011 onwards (WHO 2011). In 2011, the WHO made AMR the main theme of its annual ‘World Health Day’ with the slogan ‘Antimicrobial resistance: no action today, no cure tomorrow’. WHO Director-General Margaret Chan (2011) argued that: ‘the world is on the brink of losing miracle cures’ and ‘the world is heading towards a post-antibiotic era, in which many common infections will no longer have a cure and, once again, kill unabated’ (WHO 2011). Building on the momentum, the WHO regional office for Europe published a report in June 2011 which urged for a European action plan on antibiotic resistance. In this report, the WHO stated that:

*...the use, but especially the **overuse, misuse and underuse**, of antimicrobial agents often leads to the adaptation of micro-organisms through mutation, genetic recombination and selection, so that resistant strains may become the predominant organism in the community, health care settings or the environment’ (WHO, 2011, p. 6).*

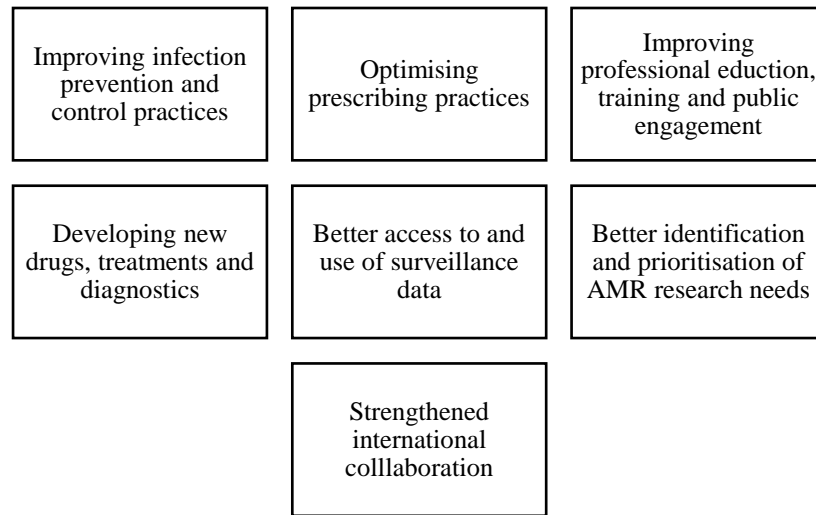
In 2011, the WHO published its ‘European strategic action plan’, which recognised AMR as a ‘global health concern’ (p. 2) and was adopted by Member States of the WHO European Region in September 2011. It promoted the development of comprehensive national action plans and the establishment of multi-sectoral and interdisciplinary coordination mechanisms. To the food animal industry, in particular, it recommended the strengthening of its surveillance of AB-use to monitor progress and continue with ‘prudent use’ interventions to reduce the overuse and misuse of livestock ABs.

#### 4.2.3 UK 5 Year Antimicrobial Resistance (AMR) Strategy 2013-2018

In response to rising international concerns, in her annual report of 2011 Dame Sally Davies, the UK Chief Medical Officer, urged the UK government to take action and amend existing strategies (Davies, 2011). She framed antimicrobial stewardship, evidence-based antimicrobial guidelines, use of relevant diagnostics and controlling prescribing for HP-CIAs as key components of the UK’s national strategy. Importantly, she not only framed solutions in terms of changing human behaviour, but also argued that the main risk for AMR is human-use rather than animal-use. In response to the CMO and the WHO, the UK Department of Health (DH) and Department for Environment, Food and Rural Affairs (DEFRA) re-evaluated the 2000 Action Plan and published the UK 5 Year Antimicrobial Resistance (AMR) Strategy 2013-2018, focusing on the following 3 strategic aims (2013, p.7):

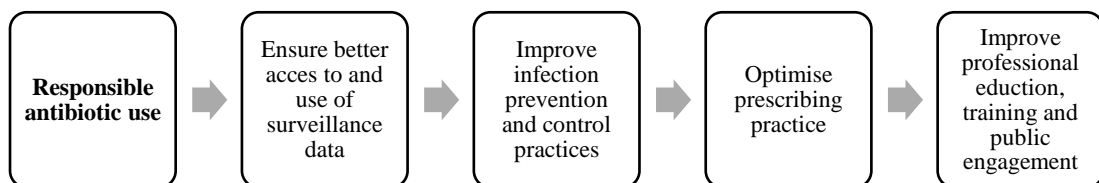
- Improve the knowledge and understanding of AMR
- Conserve and steward the effectiveness of existing treatment
- Stimulate the development of new ABs, diagnostics and novel therapies

These aims were underpinned by 7 areas for future action as shown in Figure 4.2



**Fig. 4.2:** Areas of action in the UK 5 Year Antimicrobial Resistance (AMR) Strategy 2013-2018

Emphasis in the livestock and veterinary sector continued to focus on data collection, but the rhetoric in the UK’s AMR action plan of 2013-2018 moved from ‘prudent use’ to ‘responsible prescribing’ (Figure 4.3). This located responsible AB-use on vets and farmers (UK Department of Health, 2013, p. 30).



**Fig. 4.3:** Responsible antibiotic use in the UK 5 Year Antimicrobial Resistance (AMR) Strategy 2013-2018

The action plan furthermore identified the need for research on the drivers of veterinary prescribing practices as central to minimising the pressures that influenced veterinary prescribing habits (UK Department of Health 2013, p.19).

While the livestock industries continued to be largely responsible for the governance of responsible AB-use, the relationship between sales of livestock ABs and the prescribing of the drugs came under scrutiny. At the heart of this decoupling was the possibility that vets might lose their right to dispense antimicrobials with obvious economic consequences. Supported by NOAH, the BVA claimed ‘the UK veterinary profession must win the fight to prevent decoupling’ (Vet Times, 2013). BVA President Peter Jones commented that the threat of decoupling was ‘all part of the hysteria of the Scandinavians, notably the Danes, driven by a cadre of people in the authorities there, many of whom are ex-World Health Organisation (WHO)’ (Vet Times, 2013). However, decoupling was not only a concern for the UK veterinary community; it was a concern to the livestock industry as a whole. Decoupling would mean farmers would no longer be able to keep ABs on their farms. Tackling AB dispensing from veterinary practices to farmers could destabilise the economic interests involved with AB sales and AB-use.

To remain in control of AB regulation, the agricultural industry appointed RUMA in 2013 as their AMR lead to design AMR policies and communicate evidence of action to policymakers and the public (RUMA Chairman Gwyn Jones, 2018). RUMA assumed a mediating role between different publics; representing the ‘voice’ of the industry to policymakers and the media, while maintaining the trust of the livestock industries they represented. Taking up their new role, RUMA produced a livestock antimicrobial action plan and reformulated ‘best practice’ antimicrobial guidelines. Updates of these actions were regularly communicated to policymakers and the media. This showed that the industry were accepting their responsibility for reducing ABs. It moreover safeguarded the industry’ control over ABs and diverted attention from regulatory interventions and threats of decoupling. RUMA acted as a spokesperson for the entire industry and was trusted in its role by policymakers and livestock industries. However, the respondent in the following quote questions RUMA’s claimed position in guiding the industry towards responsible use:

*“There was a question at the RUMA conference two years ago, about who is leading on AMR issues for the livestock sector”* (Respondent Livestock industry organisation 1)



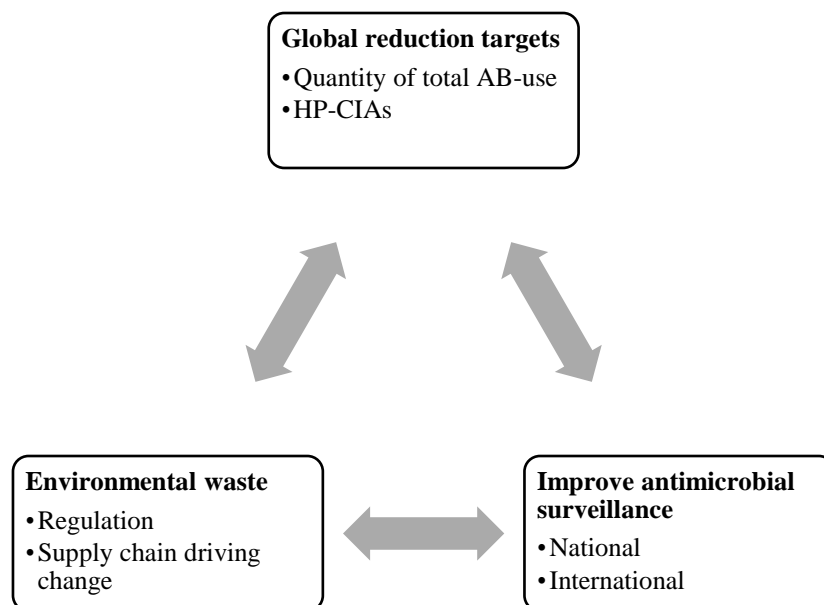
In the next section I examine how livestock AB-use was framed as a matter of concern by the O'Neill expert committee.

## 4.3 The O'Neill expert committee: making livestock antibiotic use into a matter of concern

### 4.3.1 O'Neill report 2015: The problematisation of livestock antibiotic use

In 2014, the UK government established the 'Review of Antimicrobial Resistance', chaired by Lord Jim O'Neill. At that time, the UK showed ambition to become a world leader in the governance of AMR (RUMA Chairman Gwyn Jones, 2018). The 'O'Neill committee' was set up to engage with various international stakeholders to assess the risks of AMR from an economic and social perspective. With a 'blank sheet of paper and open minds' (O'Neill 2014, p. 2), the committee published 7 reports during 2014-2016. The creation of the committee chaired by O'Neill reflected the trust placed in expert committees in the UK to settle scientific controversies through the application of independent, objective evidence on behalf of the public under the imperative of public safety (Jasanoff, 2005a). But as will become clear, these economic experts are restricted to their own economic fields of expertise (Barry, 2002), selecting which uncertainties of the problem receive priority, while leaving others unexplored. Moreover, different interests involved with the O'Neill reports steered how their scientific evidence ended up being used in further policies.

The Review's 4<sup>th</sup> report published in 2015 titled 'Unnecessary Antimicrobial Use and Waste in Agriculture' challenged worldwide antimicrobial livestock practices (O'Neill, 2015). It argued that 70% of ABs in the USA are consumed by animals while 30% consumed by humans, raising concerns on the *quantities* of ABs used in food producing animals. In order to evaluate the excessive use as a problem for human health, the report conducted a literature review to explore existing literature. They found 192 applicable papers, of which 114 openly stated livestock AB-use increases the risk of Antibiotic resistance in humans, and of which only 15 dismissed the link. The remaining papers did not make clear statements. In light of this information, the report claimed there is 'sufficient' evidence to support the link between livestock AB-use and AMR in human health. Following the international narrative of AB 'overuse and misuse' in food producing animals, the 'excessive' use of ABs in agriculture was the main focus of the report (O'Neill, 2015). Within this risk frame, the report proposed three interventions, displayed in Figure 4.4.



**Fig. 4.4:** Target area's to reduce the 'overuse and misuse' of AB-use in the 2015 O'Neill report

The O'Neill report (2015) suggested first of all to limit the quantities used in agriculture immediately and restrict HP-CIAs, especially with the crossover between ABs used in humans and animals. Firstly, using Scandinavian countries and the Netherlands as examples, the report suggested reduction to 50 milligram of ABs a year per kilogram of livestock in countries as starting point, leaving it up to individual countries how to achieve this. Harmonised global approaches were proposed to identify and reduce those antimicrobials that were of greatest importance to human health. Secondly, the report proposed radical improvement of the surveillance systems to monitor AB-use in agriculture and antimicrobial manufacturing waste. Finally, to tackle the environmental risks associated in antimicrobial production, the report suggested regulatory standards to improve waste management of AB manufacturers. It urged participants of the food supply chain to engage with companies and demand change (O'Neill 2015). To stimulate action, the report proposed the following policy interventions: 1. Implement legislation to reduce antibiotic use, 2. Implement a tax on antibiotic use, 3. Subsidise the cost of implementing infection control measures or alternatives such as vaccines and diagnostic tools (O'Neill 2015, p. 25).

### 4.3.2 Controversies

The 2015 O'Neill report received a mixed response across organisations in the UK representing the livestock industry and the media. The National Office of Animal Health (NOAH), representing pharmaceutical companies in charge of animal medicines, accused the O'Neill report of using insufficient literature and making speculative claims about livestock antimicrobial use (National Office Animal Health, 2015). The British Veterinary Association (BVA) accused the report of introducing 'arbitrary, non-evidence based target setting' (British Veterinary Association, 2015) while the National Farmers Union (NFU) was 'disappointed with the lack of context and consultation' (National Farming Union, 2015). Media sources, such as UK newspapers, constructed the potential AMR risks attached to livestock antimicrobial use as a particular feature of intensive farming systems (Morris et al., 2016). Although public concerns were raised, the O'Neill report had no legal power. It needed the agricultural sectors and policymakers in the UK to align with its proposals in order to mobilise action.

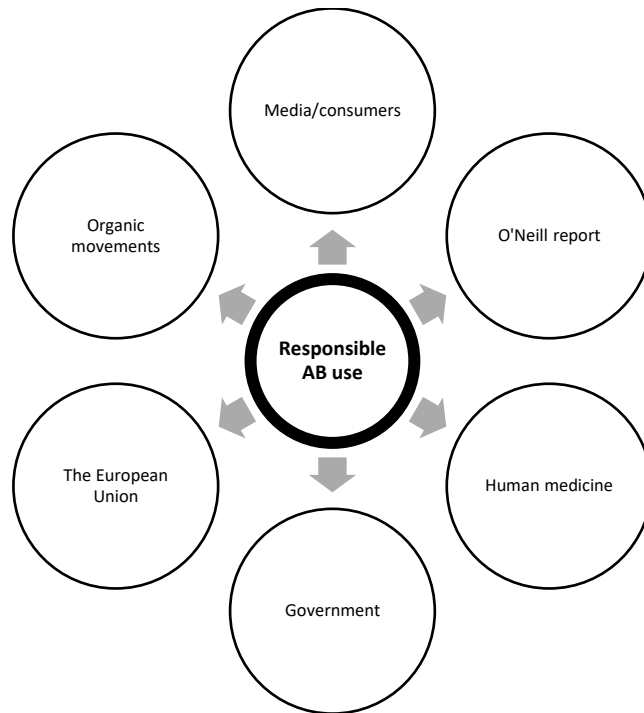
Callon (1986, p.10) defined this as the problem of translation: in order for scientists to create scientific authority, they need to 'enrol' participants, or 'allies', in their own 'problem-solution' definitions or 'Obligatory Passage Point (OPP)'. In order to successfully bring actors together on an issue of concern, scientists must show that their proposal is indispensable to those whose support it seeks. Scientists need to formulate an OPP, which ensures the involved actors can keep their interests and objectives (Callon, 1986, p. 6). Hence, the O'Neill report needed to problematise the 'misuse and overuse' into a matter of concern and re-define responsible AB-use policies of livestock ABs in such a manner that it bridged agricultural actors and policymakers. This would get the recommendations of the experts on responsible AB-use translated into action. How the final O'Neill report tailored its messages to the needs of the agricultural actors, governmental policymakers and their own agendas is explored in the next section.

### 4.3.3 How to enrol governmental policymakers and livestock industries

The 2015 O'Neill report was critical of leaving livestock AB-use in the hands of agriculture and introduced regulation, taxation, and subsidies as alternative means of producing change. But this was not necessarily in the interest of governmental policymakers.

*"I think the government is wary of making commitments that potentially lead to long liabilities or long term costs."* (Respondent Livestock industry organisation 3)

The O’Neill experts had to come up with recommendations that enabled flexibility in governance responsibilities. The recommendations on ‘responsible AB-use’ had to settle public concerns, but with as little government involvement as possible. In turn the livestock industries were increasingly confronted with various pressure groups, as presented in Figure 4.5, who accused the agricultural industries of ‘misuse and overuse’ of ABs in food producing animals (RUMA Chairman Gwyn Jones, 2018).



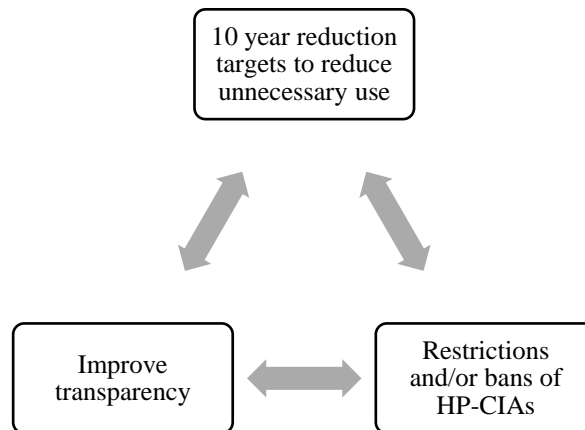
**Fig. 4.5:** Pressure groups in the UK that urged to reductions in livestock antibiotic use

Fearing legislation, the livestock industries became obliged to engage with the responsible AB-use debate in order to provide evidence of responsible AB-use activities. However, the livestock industries wanted to maintain control of *their* ABs. To governmental policymakers and the livestock industries, responsible AB-use was a concern with a willingness to engage, but on certain conditions.

#### 4.3.4 O’Neill report of 2016: building alliances

In their final report, the O’Neill Committee re-stated that there is ‘an increasingly robust consensus that unnecessary use of ABs in animals and agriculture is a significant concern for

human health’ (O’Neill, 2016, p. 24). Three broad steps were proposed to improve the situation, presented in Figure 4.6.



**Fig. 4.6:** Target area’s to reduce the ‘overuse and misuse’ of livestock AB-use in the final 2016 O’Neill report

Firstly, the report proposed that countries should, by 2018, come up with country-specific sales reduction targets consistent with their economic development and production systems. For high-income countries, a target of 50mg/PCU<sup>6</sup> should be initially aimed for in the short term. New targets should then be set after these in order to continue progress. The report also contained recommendations on how to achieve these reduction targets. Changes in production practices, the introduction of alternatives such as vaccines, improvement of animal husbandry systems, veterinary and farmer awareness and education, and public/consumer awareness were also put forward as other ways to reduce agricultural AB-use. The O’Neill experts (2016) stated that reduction targets would force farmers to move away from non-therapeutic use to solely therapeutic use. Secondly, in line with the 2015 O’Neill report, the experts in 2016 urged harmonisation of definitions and classification of HP-CIAs, and identification of these whose use in animals presented the greatest potential risk to people. Surveillance, monitoring and oversight of AB use were framed as interventions to speed up control of HP-CIA use. Thirdly, to improve transparency, the food chain was identified as a crucial actor. By setting

<sup>6</sup> PCU is the measurement standard set by the ESVAC (European Surveillance of Veterinary Antimicrobial Consumption). The calculation standard estimates the weight of the animal (or group) at the time of receiving an antibiotic. The unit is now used across EU Member States and is an approximation of consumption, extrapolated from sales data (VMD 2018).

reduction targets and making surveillance data on AB-use mandatory, supply chains could have a real impact in driving change. Food supply chains should, moreover, agree on responsible AB-use standards, which could be developed as internationally recognised labels or used by existing certification bodies. In return, food chains could use labels of ‘responsible AB-use’ to help consumers make informed decisions as to how ABs have been used in the products they buy (O’Neill, 2016).

The final O’Neill report (2016) provided a clear economic lens on livestock AB-use as matter of concern: by producing evidence of responsible AB-use, livestock supply chains could add value to their livestock products. Although the report identified the use of governmental regulation, taxation and subsidies of alternatives to lower AB-use, particular focus was given to investments in vaccines as drivers for change. In a similar vein, Brown and Nettleton (2016) argue that O’Neill, as the UK’s ex-prime minister David Cameron’s appointed economist, provided imaginative economic spaces of AMR as a market opportunity. The authors highlight the relationship between AMR and political neoliberal market agendas in the UK (Brown & Nettleton, 2016). Equally, the targets in the final O’Neill report of 2016 are designed to reinvigorate economic markets. Achieving reduction targets in food supply chains was positioned in the report as an economic strategy to attract consumers, while it opens up new pharmaceutical investment opportunities in vaccine development and diagnostic tools on farms. Countries, their agricultural sectors and their food supply chains have in turn taken responsibility for implementing antimicrobial reduction strategies. As will be discussed next, this enabled the UK government, agricultural sectors and food supply chains to take ownership of the content of antimicrobial reduction targets.

#### 4.3.5 Consolidation around ‘responsible antibiotic-use’

##### **Agricultural response**

In response to the O’Neill report of 2016, RUMA (2016) ‘welcomed’ on their website its ‘main’ findings, but raised concerns about the setting of ‘inappropriate’ targets:

*“We also understand the report’s ambition to develop long-term targets. The industry has long recognised the beneficial role targets can play, but is acutely aware that inappropriate targets can also be counterproductive and even lead to increased risk of resistance”.* (RUMA 2016)

Livestock industry groups responded (and still do) with ‘animal welfare’ claims. They claimed that inappropriate reduction AB targets can cause danger to the health of food producing

animals.

*“I don’t think it is about drilling down to the lowest possible number. It is about making sure you are using things properly, in a way that you maintain the welfare, you maintain the good health of your animals, and your people.”* (Respondent Livestock industry organisation 1)

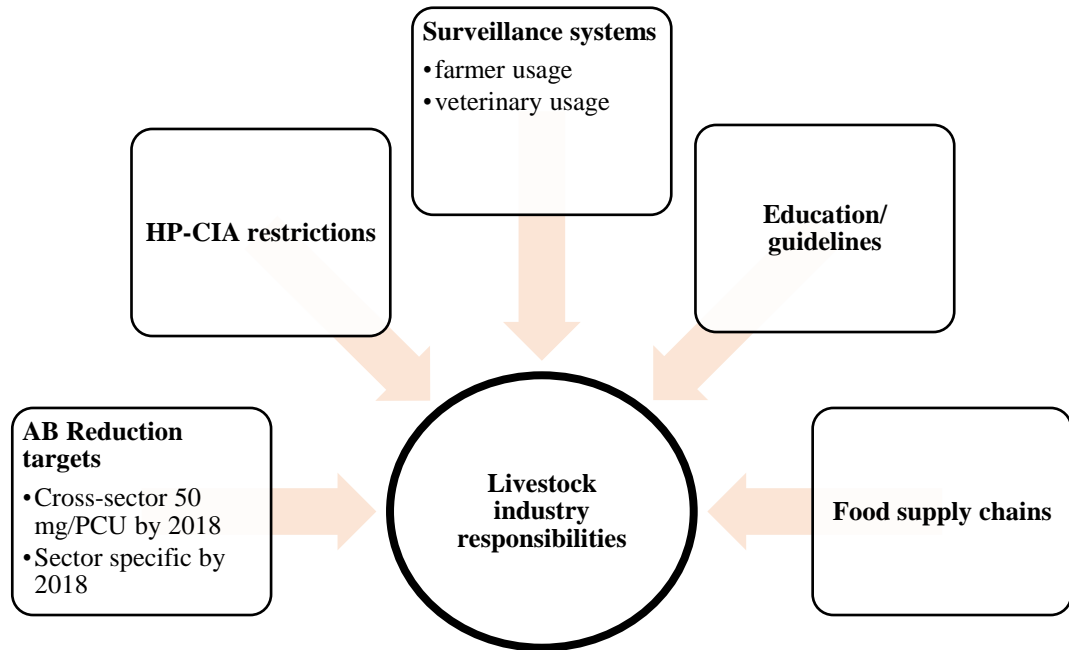
Historically, the concept of animal welfare has been based on ethical and moral concerns (Harrison, 1964; Woods, 2012). A lack of unified scientific definitions over the decades on the meaning and measurement of animal welfare has created a ‘black box’, in which the internal complexity of animal welfare is obscured but which still retains a widely accepted rhetorical authority (Latour, 1987). Even though animal welfare remains a complex concept, UK consumers expect high animal welfare standards of the animal products they buy. With the UK livestock industries managing the health and welfare of ‘animal bodies’, the livestock industries use the concept of animal welfare as a defence mechanism whenever agricultural interests are threatened by debates. Adding animal welfare into the conceptual framework of responsible AB-use appropriates a degree of ownership over the proposed targets. In so doing the industry established a legitimate role in defining the content of the proposed reduction targets set out in the 2016 O’Neill report.

RUMA (2016) highlighted on their website the importance of a ‘UK focus’ in how targets should be set. They announced the creation of an industry ‘Task Force’ to develop meaningful reduction targets together with the sectors, to ‘replace, reduce and refine’ the use of ABs in the UK’s livestock sectors (RUMA, 2016).

### **Governmental response**

In 2016, the UK Department of Health published a policy report that responded to the 2016 O’Neill report (Department of Health, 2016). In the policy report, DEFRA and the VMD as policy bodies, committed to support the livestock industries in reducing livestock antimicrobial sales (antimicrobials sold by pharmaceutical companies) to a multispecies average of 50 mg/PCU by 2018 (from 62mg/PCU in 2014) and restrict HP-CIA use across livestock sectors (Department of Health, 2016, p. 7). Individual sectors were appointed to design sector specific overall and HP-CIA reduction targets by 2017, supported by improvements in animal husbandry, stockmanship, biosecurity practices and disease prevention (Department of Health, 2016, p. 7). The veterinary organisations were made responsible for the production of AB information and guidelines. Aside from the VMD

monitoring AB sales, surveillance of AB usage was transferred to the individual livestock sectors/food supply chains. The key targets of the policy report are presented in Figure 4.7.



**Fig. 4.7:** The UK's livestock industry-led voluntary approach to tackle the 'misuse and overuse' of ABs in food animals

DEFRA agreed to work 'closely' with the VMD and the different individual sectors to set appropriate sector specific reduction targets by 2017. By supporting sector-specific targets while circumventing long-term engagement with the agricultural sectors, the UK government was able to delegate control of responsible AB-use of antimicrobials to the agricultural sector.

#### 4.3.6 The co-construction of RUMA

RUMA's role on AMR has continued to grow. The interviews confirmed that through their AMR action plan, RUMA is viewed as leading the livestock sectors on responsible AB-use.

*"In essence, RUMA is leading the livestock sectors in the UK on responsible use of antibiotics". (Respondent Livestock industry organisation 1).*



RUMA set up an industry ‘Targets Task Force’ in 2016 to facilitate the development of sector-specific reduction targets and AMR policy objectives (RUMA, 2017). The Targets Task Force consisted of a leading vet and farmer from each livestock sector who had to consult with their respective industries to set objectives. The setting of industry-led targets in cooperation with the livestock industries is underpinned by the belief that change can be achieved and the imposition of regulation can be avoided. The Targets Task Force published their sector specific antimicrobial policy targets in 2017.

In 2017, RUMA received a ‘significant amount of money’ from their members that then was largely invested in effective communication, including hiring a communication consultant to better communicate ‘responsible AB-use’ actions to the public and to the industry (RUMA Chairman Gwyn Jones, 2018). The money was also invested in a Farmer Task Force and an Independent Scientific Group that would evaluate AMR strategies. RUMA keeps working closely with the VMD by providing them with updates on policy actions. RUMA argues that this ‘makes lives easier for the VMD and government’ (RUMA Chairman Gwyn Jones, 2018), confirming the UK’s government interest in delegating AMR responsibilities to the livestock industry. The previous discussion shows how RUMA’s position as the industry AMR policy-lead and spokesperson has been strengthened since the O’Neill reports. This reduces the risk of the industry being externally regulated, while maintaining control on the content of agricultural AB policies.

#### 4.4 Metrics as ‘evidence’ of successful governance

As I have demonstrated in this Chapter, the ‘overuse and misuse’ of livestock AB-use has been successfully translated into a matter of concern. By delegating regulatory responsibilities to the livestock industries and attaching economic interests to responsible AB-use in the final O’Neill report (2016), the economic experts established a successful alliance with governmental policymakers and livestock actors. The report defined identities and their responsibilities around responsible AB-use as OPP, ‘locking actors into place’ (Callon, 1986, p. 8), for which the alliance members in return were able to pursue their own agendas.

As Callon (1986, p. 19) frames it:

*“Translation is a mechanism by which the social and natural worlds progressively take form. The result is a situation in which certain entities control others. Understanding what sociologists generally call power relationships means describing the way in which actors are defined, associated and simultaneously obliged to remain faithful to their alliances. The repertoire of translation is not only designed to give a symmetrical and tolerant description of a complex process which constantly mixes*

*together a variety of social and natural entities. It also permits an explanation of how a few obtain the right to express and to represent the many silent actors of the social and natural worlds they have mobilised.”*

The UK government has provided a policy framework within which other people have been made accountable for delivery, resulting in the UK’s industry-led voluntary approach. Although progress needs to be briefed to the UK government, it allows the industries to remain in control of the approaches and practices to reduce use and achieve responsible AB-use. Within the industry-led policy frame, metrics have become ‘technocratic’ mechanisms to make claims upon responsible AB-use practices: they represent the many silent actors in the AB agricultural networks. Moreover, the O’Neill experts re-formulated what it *means* to produce metrics on AB reduction targets: it delivers economic imaginaries to food supply chains. In the UK (and beyond), the production of metrics on AB-use across food supply chains in the UK is considered by governmental policymakers, livestock industries and consumers as a ‘trustworthy’ source. By providing numbers of AB reduction, food supply chains can add value to their food products by claiming that ABs are used responsibly. This creates new spaces for the UK food supply chains to market their livestock products.

Consequently, metrics as non-human actors disperse knowledge and transparency in relation to ‘how the industry is doing’; metrics signal progress or otherwise. Over the time period 2013-2017, Figure 4.8 shows that overall sales of ABs across sectors has been reduced by 40% in 2017 in mg/PCU in the UK (UK-VARSS, 2018)

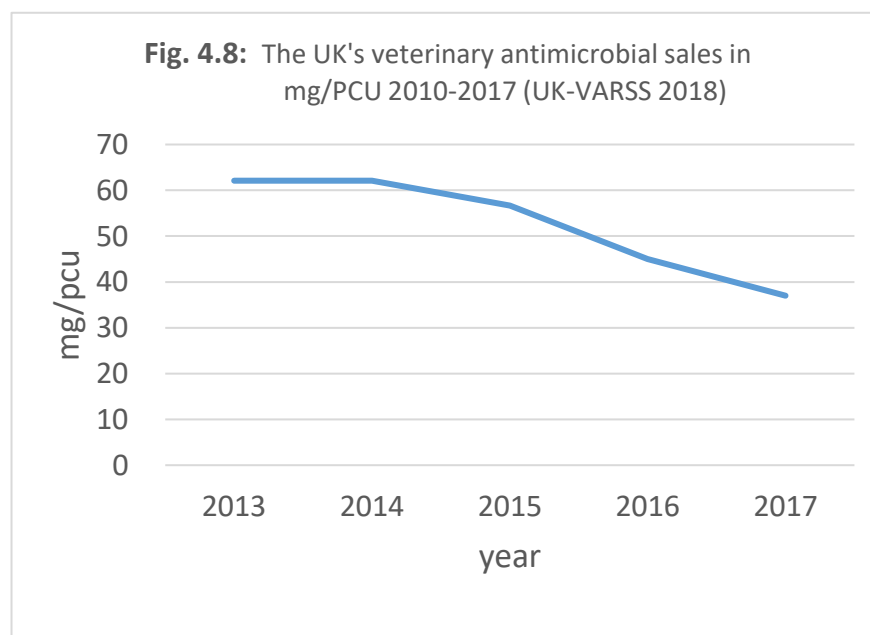


Table 4.3 shows that HP-CIA sales have been reduced across sectors, with a 55% drop in fluoroquinolones (mg/kg) compared to 2013, 32% drop of 3/4<sup>th</sup> generation cephalosporins (mg/kg) and a 99% reduction in Colistin (mg/kg).

**Table 4.3:** The UK’s veterinary sales of critically important antibiotics in mg/kg and total veterinary antibiotic sales in tonnes of active ingredient in food-producing animals between 2013 and 2017

Sales	2013	2014	2015	2016	2017	Compared with 2016	Compared with 2013
<b>All ABs (mg/kg)</b>	62	62	57	45	<b>37</b>	↓ 18%	↓ 40%
<b>Fluoroquinolones (mg/kg)</b>	0.36	0.35	0.34	0.23	<b>0.16</b>	↓ 30%	↓ 55%
<b>3th/4th generation cephalosporins (mg/kg)</b>	0.18	0.19	0.17	0.15	<b>0.12</b>	↓ 21%	↓ 32%
<b>Colistin (mg/kg)</b>	0.11	0.12	0.12	0.02	<b>0.001</b>	↓ 94%	↓ 99%
<b>Total sales (All animals, tonnes)</b>	436	448	408	338	<b>282</b>	↓ 17%	↓ 35%

*Note: Adapted from the Veterinary Medicine Directorate UK-VARSS report 2018*

## 4.5 Externalities/overflows

The O’Neill report of 2015 uses the concept of externalities to discuss the positive and negative effects of AB-use to third parties. A negative externality occurs when farmers use ABs in their food animals that potentially increases resistance rates in society. Positive externalities occur when farmers introduce AB alternatives that reduce antimicrobial need. Importantly, the report argues lower quantities of antimicrobials used in agriculture results in positive externalities to third parties, such as society and markets (O’Neill 2015, p.25). AB metrics are used by the alliance to build trust in their ‘successful’ industry-led approach. It will however become clear throughout the rest of this thesis that metrics only partially present what is *practiced*. Moreover, the metrics in themselves ‘perform’, as they produce new relations across institutional and food supply chain settings, with intended and unintended effects. Callon (1998) refers to externalities as the ‘framing/overflowing’, in which he argues how overflows of issue framing are, however, the norm instead of exception. By studying overflows instead

of ignoring them, we can, potentially, manage their unintended effects. I will focus my attention in this next section on how network priorities results in overflows.

#### 4.5.1 Limitations of antibiotic surveillance policies, their governance and what they represent

In the interviews I conducted with the key players, concerns were expressed about the consequences of the policy focus on data collection and the rhetoric of reduction. While a downward trend in AB-use could be defined as progress, there was an awareness that a disease outbreak could reverse this trend leading to a loss of trust by the public.

*“My concern about the emphasis politically we put on measurement, is when we have the next disease outbreak that will cause antimicrobial usage to dramatically increase. So governments like to put out ‘oh we are making progress, we are making progress’, but sooner or later... We have created a, a media and public expectation of continual reduction. And how do we, how are we as an industry, going to manage that scenario without a massive loss of public trust during the next disease outbreak?”* (Respondent Pharmaceutical Company 1)

The narrow focus of the debate on AB reduction was questioned, as this limits investment in understanding whether a reduction actually changes anything.

*“There is too much of a focus on collecting the information than actually the important thing is how are we going to actually manage and check or promote for improvement of results of the use of antibiotics.”* (Respondent Livestock industry organisation 4)

Comments were made about the responsibilities involved in data surveillance governance. The UK livestock sectors are responsible in the UK’s industry-led approach for designing and implementing a sector AB usage surveillance system. This has resulted in individual sector approaches across the UK livestock industries and some have been more successful than others up until now. The highly integrated poultry industry, guided by the British Poultry Council (BPC), has been able to implement an AB usage surveillance system covering 95% of the industry (UK-VARSS, 2018). Less integrated livestock sectors in the UK, such as the dairy, beef and sheep industry, have struggled to set up an overarching AB usage data surveillance system in their sectors, due to problems of commitment, data access and complexities involved with system design limit progress. Consequently, aside from the poultry industry, there is no other livestock sector that has full transparency in how ABs end up being *used* (UK-VARSS,

2018). In addition, it was argued that livestock sector data surveillance responsibility limits the spending of UK livestock sectors in terms of their time and resources to do other important responsible AB-use activities. Comparing the data surveillance approach in other countries, comments were made about government responsibility:

*“I think that, my own view is that, the VMD should step up and say we need to know where all antibiotics end up being used in the UK and therefore anybody who dispenses antibiotics should be prepared to send it to a national database, pretty much the same way as this happens in the Netherlands, Denmark or Germany and elsewhere. I don't think that would have been all that expensive and indeed government could have thought to recover the costs of actually doing that. But instead it said well, no we will let industry decide how this data could be collected and present that information to us. I think without legislation it is difficult to force people to engage with the insistence and equally it is difficult to police when you have no national system. So I think the industry will try hard, but I am not sure how successful it will be in capturing the endues of majority of antimicrobials, and I think therefore it would have been achieved much easier by having a simple vet discipline framework for doing that, and then the industry efforts could have been focused on actually, how do we reduce the amount of antimicrobials being used and check or promote for improvement of results of the use of antimicrobials, rather than just focusing on how do I collect that information”.* (Respondent Livestock industry organisation 3)

As previously discussed, AB sales metrics need to be interpreted with caution. Figure 4.10 shows how reduction was starting to take place from 2015 onwards prior to the publication of the O'Neill report in December 2015 (UK-VARSS, 2015). It can be argued that the policy efforts of the UK government and RUMA were already starting to translate into the reduction of AB sales. However, the driving force behind the reduction in sales between 2014-2015 needs to be interpreted with caution, as it was not necessarily political pressure and RUMA that drove this reduction. Evaluating each individual livestock sector, the pig and poultry achieved together a reduction of 23% in the year of 2014-2015. In contrast, other livestock sectors, and also companion animal and equine sectors, increased AB sales in the same timeframe can be observed (UK-VARSS, 2015). An important explanation for sector differences is that the pig, and particularly the poultry industry, were criticised in the media and by pressure groups for intensive husbandry systems and their high use of ABs in contrast to other sectors. They were therefore already engaged with the issue before the publication of the O'Neill reports. This was driven from within the sectors to maintain public confidence and will be discussed more in depth in Chapter 5.

*“The poultry meat sector took hold of this baton of foodborne pathogens much earlier than anybody else and recognised the issues developing in poultry meat. They have been collecting information and making policy decisions since about 2012, so they are ahead of the game in terms of other species groups.”* (Respondent Livestock industry 1)

AB sales only represent the distribution from ABs to veterinary practices. Vets prescribe and dispense the ABs to farmers. This is the most risky trajectory of the AB, as this will define how ABs will be used (animal, purpose/indication, administration route, dosage, days, etc.) and can pose a risk to human health if used inappropriately. Although reduction in sales of both overall ABs shows very promising results according to the latest VMD report (UK-VARSS, 2018) it is hard to draw conclusive results upon what these results represent.

*“What are we measuring? I mean, we can measure, so can measure if we look at, say within a treatment class, we can measure trends from year to year in that treatment class, and we are measuring something. But if I am measuring, if I am adding together kilos of tetracycline and kilos of fluoroquinolones. What does that mean? It doesn't mean anything at all”.* (Respondent Pharmaceutical Company 1)

At the same time, the UK's HP-CIA sales data in food-animals presented in table 4.3 show a reduction in sales per class. It gives little information upon how HP-CIA's end up being used in animals and whether other ABs are being used to support the reduction in HP-CIA use.

*“We don't have great knowledge on much aspects on how antibiotics are used and what they are used for, so we lack the data we lack the detail, that means we lack the capacity to identify whether or not improvements are made or reductions are made on the matter how antimicrobials are used[...]. We don't really know for a start how much antibiotics are being used in the cattle industry, we have various estimates, but they really are estimates they are not, there is no actual data, and one of the challenges is that there are quite a lot of mixed farms in the UK, so when people buy drugs they are probably going to use it on sheep or beef or dairy, that is all to be addressed.”* (Respondent Livestock industry organisation 4)

#### 4.5.2 Risky Critical Important Antibiotic (CIA) policies

During the interviews a vet (Veterinary surgeon 7) expressed his concerns about how a rise in non HP-CIA use will translate itself in resistance profiles of non HP-CIAs. With non HP-CIAs compensating the loss of other AB classes, resistance may be more likely to develop in relation to these now more heavily-used classes. Consequently, if resistance to non HP-CIAs increase, this could lead to a higher need for HP-CIAs as ABs of last resort. Pharmaceutical companies

also expressed concerns about the future commercial viability of veterinary HP-CIAs.

*“How we access the medicines in case you need them is important in the interest of society, but there is a cost to industry to maintaining the medicine when they’re not used”.*

(Respondent Pharmaceutical Company 1)

As Reynolds Whyte et al. (1996, p.85) have argued, ‘only what is perceived as valuable will become an item fit for exchange and trading’. By restricting or banning HP-CIAs from livestock use, the market value of HP-CIAs is reduced, which could eventually result in pharmaceutical companies deciding to stop producing and selling HP-CIAs to veterinary markets. This could pose risks to the welfare of animals which may end up suffering from infections that cannot be cured by non HP-CIAs.

The O’Neill report (2015, p.21) challenged the ‘lack of consistency in definitions of antimicrobials critical to human use’ across official organisations and livestock sectors, because of its impact on making comparisons difficult. The report called for unification of HP-CIA antimicrobial risk classifications, as this would increase the possibility to evaluate ‘individual process or reports’ on the matter (O’Neill, 2015, p. 21). In the UK, national inconsistency can still be observed, as the British poultry industry uses the WHO HP-CIA classification while the rest of the livestock sectors use the EMA HP-CIA risk classification.

#### 4.5.3 Fragmented antibiotic policies

As O’Neill (2016) had in mind, the supply chain actors are making ‘responsible medicine use’ into an economic opportunity. Çalışkan & Callon (2009, p.391) have introduced the concept of ‘economisation’ to identify and characterise how entities become ‘economised’. In this context each food supply chain actor has different economic concerns and interests, causing a different ‘economisation’ of responsible AB-use.

*“Retailers are given a competitive market place and they are all seeking to find whether there is an opportunity for commercial advantage, and so, retailers and processors have their own policies and strategies on this.”* (Respondent Livestock industry organisation 4)

The fragmented AB policies have resulted in different AB practices, rather than standardisation. Taking the dairy supply chain as a case study, this process and its public health and environmental risks will be extensively discussed in the next Chapters.

#### 4.5.5 The structure of animal husbandry sectors as a barrier to policy

In the interviews, one of the retailers highlighted the impact of different animal husbandry systems on the supply chains. The size and diversity within each sector were identified as potential barriers to the communication of responsible AB-use messages.

*“I mean, the poultry sector has a much easier starting position, because there are such a small number of businesses, and they were able to get together and address it almost as a sort of corporate issue. Whereas the pig sectors, there are still a number of large corporates who cover about 50% of production. But there are a lot of other smaller farmers who do the other 50%. When you move into the cattle and the sheep sector, it is much smaller. The farmers are smaller, more diverse, and there is many more of them. I suppose beef is in a much more diverse position than dairy, because they have the link through the milk processors, the first buyers. But on the beef and sheep side, it is just a lot of disparate, small farmers, small to medium sized farmers, carrying out their business on a daily basis, so it is much more difficult to get a hold of them and to get the message across to them” (Retailer 2)*

#### 4.5.6 Husbandry systems as environmental risk

Although the beef, sheep and dairy industries use far less quantities of ABs than the pig and poultry industry, they could potentially pose a higher environmental AMR risk. These sectors are more extensive in their husbandry systems compared to the intensive pig and poultry industry, which means animals spend more time outside on lands and are more exposed to the environment. Through their secretions and environmental contact, they could pose selective pressure to environmental bacteria (Fieldnotes, Veterinary surgeon 9). At the same time animal dung and milk waste are still entering slurry and/or are disposed on the land, which makes its way onto agricultural land. There is also a lack in oversight on what happens with medicine waste on farms. This issue has been positioned by a RUMA speaker as the big upcoming issue for the future (RUMA Chairman Gwyn Jones, 2018).



## 4.6 Conclusion

Following Callon's (1986) lines of reasoning on how issues become constructed as a 'matter of concern', the analysis presented in this Chapter shows how an 'alliance' (livestock antimicrobials, economic expert committee, policymakers and livestock industry stakeholders), a problem-solution program or OPP ('responsible AB-use) and continuation of interests, translated itself into the UK's technocratic industry-led voluntary approach.

The workings of the UK's political culture manifests itself in how economic experts were given the responsibility by the UK government to produce 'technical regulation' to provide calculations of progress. Economists increasingly rely on measurement and information to capture phenomena (Barry, 2002). In the case of livestock ABs, calculation as technocratic intervention and trustworthy evidence was prioritised by the O'Neill economic expert committee. According to Callon (1998), a situation must be framed first before they become calculable. Hence, by taking over the international narrative of AB 'misuse and overuse' in food producing animals, the O'Neill economic experts made livestock AB-use a calculable concern. More importantly, this particular framing with its solutions enabled the economic experts to translate the political debate into the economic field (Barry, 2002). Consequently, AB metrics not only serve as anti-political tools that serve the UK's agricultural neoliberal strategies, but also as economic imaginaries (Brown & Nettleton, 2016) by their market value in retailer businesses.

The role of the farming lobby in the UK and their influence on how debates are framed and how scientific evidence is produced and used by policymakers has also been discussed in this Chapter. The rising power of RUMA as the AMR industry-lead is an example of how strategic the agricultural industry has been in relation to this issue. By establishing itself as a trustworthy spokesperson, the organisation has been used by the agricultural industry as an instrument to maintain ownership over livestock ABs. Whenever trust in the industry is de-stabilised by either public or scientific concerns, RUMA uses truth-claims about animal welfare and properties of ABs to re-appropriate control, reinforcing the message that it is the industry that should manage livestock AB-use. Hence, with the farming lobby putting their interests forward, precautionary AB policies that tackle the *need* to prescribe and use ABs are set on hold.

Even though a successful alliance between experts, the government and livestock industry has been achieved for now, relations are continuously changing. Barry (2002) highlights the instability of framing and the fragility of metrological fields. Metrological regimes first of all increasingly rely on standardised procedures. As discussed, the standardisation of surveillance

mechanisms, measurement standards, and quality parameters are absent, which increases the vulnerability of the trustworthiness of the presented data. At the same time, metrological regimes are not able to capture the ‘complexity of objects and practices in actuality’ (Barry, 2002, p. 275). They only represent knowledge about the parameters that make up the frame, ignoring what happens outside the frame. This is what Wynne (1992, p. 114) has referred to as the ‘built-in’ ignorance of science towards its own limitations. As Wynne (1992, p. 114) argues, scientific knowledge presents ‘a restricted agenda of defined uncertainties – ones that are tractable – leaving invisible a range of other uncertainties’. One way to explore what the metrological data actually represents is by opening up the metrics we get presented by the industries. Following Latour (1987, 2005), matters of fact need to be turned again into matters of concern in order to scrutinise their weaknesses and uncertainties.

The following Chapters will examine how dairy supply chains *do* responsible AB-use in accordance with the logics of *their* agricultural networks. Chapter 5 will introduce how the UK dairy industry is governed in order to understand what human and non-human actors make up the actor-networks of dairy supply chains. Chapter 6 and 7 will next discuss how decision-making regarding AB policies and their practices takes place as a network activity between the identified human and non-human actors in dairy supply chains. This will then allow a discussion in Chapter 8 of the public health implications in making supply chains responsible to govern antibiotic practices.

## **Chapter 5**

An introduction to the UK dairy sector and its regulation

## 5.1 Positioning the dairy sector

The UK is the tenth-largest milk producer in the world and the third-largest milk producer in the EU after Germany and France (RUMA, 2017). There are currently 12,000 active British dairy farmers with nearly 1.9 million dairy cows who produce just under 15 billion litres of milk each year (RUMA, 2017). Dairy farmers produce raw milk, which is bought by milk processors who transform it into liquid milk and dairy manufacturing products that can be sold to retailers. The regulation of the dairy supply chain in the UK is complex. This Chapter will detail how milk processors and retailers have become responsible for milk quality control and milk safety in the UK dairy sector.

The Chapter starts by introducing how the UK dairy sector was a state-producer, led by the UK Milk Marketing Board, up until 1994. This ensured that milk prices and milk volume were centrally determined (in contrast to other European countries). I then move on to discuss how deregulation resulted in the abolition of the UK Milk Marketing Board and how the UK dairy industry became regulated instead (Feindt & Flynn, 2009; Wales et al., 2006). Finally, this Chapter explores the impact of milk contracts on milk producers and supply chain parties.

## 5.2 Early dairy sector regulation: From state-producer to milk supply chain control

### 5.2.1 The British Milk Marketing Board (1933-1994): supply-led orientation

In the early 20th century, liquid milk was considered to be the most difficult product to market by the agricultural sector, due to its difficulty to transport and perishable nature (Empson, 1998). This resulted in fluctuating milk prices and unstable British liquid milk markets (Empson, 1998). To address the difficult market conditions of milk, the British Milk Marketing Board (MBB) was established in 1933, which represented a 'state/dairy industry alliance in milk production and marketing' (Cox et al., 1986, p. 478). The MBB was producer-run and was the sole collector of milk from producers and the sole seller of milk to the processing sector (Bates & Patisson, 1997). Subsequently, the NFU became involved in 1945 as the organised representative of dairy farmers (Cox et al., 1986). The MMB served as the milk broker between producer and the milk processor companies responsible for turning raw milk into liquid milk, and for manufacturing products such as fresh dairy desserts, commodity products (such as butter, cream), or a combination of the former (Banks & Marsden, 1997). Milk processors either directly sold their products to consumers or sold them to retailers. The

MMB operated a farm allocation system through which it received detailed information about the farms which it licensed, offering transparency in origin of milk (Banks and Marsden 1997). The policing of milk safety was at that time still the full responsibility of the UK government. The UK 1947 Agriculture Act (Grant, 2005), introduced by the post-war Labour government, gave guarantees of prices and assurances of markets for principal agricultural products. Through annual reviews, the NFU with technical assistance and support of the Board, negotiated the price guarantees for milk (Grant, 2005). The British MMB and milk market regulation by the UK government was unique in comparison with other European countries at that time, where milk prices were determined by the free market. The monopoly of the MMB tried instead to maintain a ‘balance between the interests of UK dairy farmers and the needs of dairy processors’ (Bates & Patisson, 1997, p. 50). Farmers were free to produce any amount of milk once they were licensed by the Board who in return collected their raw milk. The Board paid farmers a minimum ‘pool’ price based on the total income from all markets, defined monthly in cooperation with the UK government (Banks & Marsden, 1997, p. 387). The milk price farmers received for their raw milk was at that time solely defined by the pool price and its destination: liquid milk or manufactured products. Milk quality, safety (hygiene) and environmental parameters had no role yet in milk prices and milk contracts. The state-producer control of milk price, production and milk markets prevented the private marketing of dairy products in the decades that followed (Empson, 1998).

In contrast to the UK, European dairy markets became increasingly populated by competitive milk-cooperatives which collected raw milk and processed it into consumable products (Empson, 1998). In 1994, with the abolition of the MMB the UK dairy supply chain arrangements changed. The UK entered a global dairy market where milk processor co-operatives dominated, as presented in Table 5.1.

**Table 5.1:** The co-operative structure of the dairy industry in 1994

<b>% Share</b>	<b>Co-ops</b>	<b>Liquid</b>	<b>Butter</b>	<b>Cheese</b>	<b>Powder</b>
UK	0	0	0	0	0
Holland	82	86	96	88	75
France	50	52	51	36	53
USA	50	16	42	42	81
New Zealand	98		100	100	100
Australia	70	12			

*Note:* Adapted from Credit Lyonnais Laing (1996); cited in Banks and Marsden (1997)

As will become clear in the following paragraphs, new forms of regulation, competition and also uneven power relations within food supply chain relations emerged. In what follows, a brief overview of important European events will be provided that not only incentivised but also shaped how the dairy industry responded to de-regulatory change.

## 5.2.2 Europe: from market intervention to demand-and consumption oriented regulation

### **Europe's Common Agricultural Policy (CAP)**

When the UK became part of Europe in 1973, it became part of its Internal Market and of Europe's Common Agricultural Policy (CAP). The CAP had been established in 1962 to guarantee minimum levels of production and ensure a fair standard of living to farmers (European Union, 2012). Market and price support was implemented to support the agricultural sectors and protect countries from outside import. Through subsidies from the CAP, farmers across Europe were able to buy equipment, renovate buildings and obtain better seeds and fertilisers. Supported by minimum prices, food production in post-war Europe rose (European Union, 2012). The control of food production systems and safety in the UK and other European Member Governments was largely controlled by national governments (Ansell & Vogel, 2006). To remove trade barriers between European members, the 1979 Cassis de Dijon judgment tried to harmonise food chains across Europe through a process based on 'mutual recognition' (Grant, 2012, p. 1034). This meant that national Food Safety laws/standards of a Member State had to be accepted in other Member States, to guarantee the free traffic of 'safe' food. The free traffic of food could be denied where public health concerns could be objectively demonstrated (Grant, 2012, p. 1034).

### **Milk quota**

The productivist principles of the CAP soon led to food surpluses and 'food mountains' with demand lagging behind supply (European Union, 2012). In dairy industries across Europe, 'milk lakes' and 'butter mountains' raised increasing concerns. In response, the CAP started to implement specific measures to align supply with market demands (European Union, 2012). In 1984 the overproduction and surplus of milk products were tackled through the implementation by the EU of dairy quotas/milk quotas (Costa-Font et al. 2018). Member States had to pay a levy to the European Economic Community (EEC) if they produced more than

the reference quantity. The UK milk supplies became fixed at 85% self-sufficiency that is, UK producers were able to produce only 85% of domestic demand (Bates & Pattison, 1997, p. 50). This regulation resulted in structural shifts in the UK dairy farming industry, moving towards improving yield per cow relative to inputs with a focus on stock genetics (Banks & Marsden, 1997). It shaped how the UK dairy industry responded to de-regulation, as dairy companies had to compete to contract farmers in order to secure their milk supply.

### **De-regulating food safety and food quality control**

In the 1980s, free market ideologies gained popularity across Europe, resulting in new systems of food safety and food quality governance (Grant, 2005). In 1989, the European Commission (1989) published Council Directive 89/397 on the official control of foodstuffs, in which each EU Member Government had to carry out food inspection controls in accordance with the Directive and ensure safety at every level of food production. New food supply chain responsibilities to control food safety and food quality started to emerge. Following this EU Directive, in 1990, the UK implemented the 'Food Safety Act 1990', in which food safety responsibility was shifted towards food supply chain control. The UK 'Food Safety Act 1990' embodied the principle of 'due diligence', which requires that every food chain actor adopts food safety standards and takes all reasonable food safety precautions (Bailey, Tully, & Cooke, 2015, p. 15). This was further incentivised by the European introduction of the Single Market with free trade of goods, capital services and labour in 1993, which pushed for integration and harmonisation of food safety and quality in food production systems (Halkier & Holm, 2006; Wales et al., 2006). In 1992, the CAP shifted from market subsidies to producer subsidies: price support was replaced by 'direct payments' (Common Agricultural Policy, 2017). A shift was taking place in food production governance, from State-led to supply chain-led governance.

### **New identities: consumers and retailers**

The shift in food production governance, from State-led to supply chain-led was, however, not only the result of de-regulatory actions. A number of animal diseases and food safety issues in food chains throughout the 1980s-1990s, such as BSE (Grant, 2012), made consumers question institutional control mechanisms in the national and European food sectors (Wales et al., 2006). Consumers and media sources blamed the productivist attitude of the CAP. Sociologist Ulrich Beck (1992) captured this process in his concept of 'reflexive modernization', in which existing practices of risk management become challenged in societies. In what Beck (1992) refers to as 'subpolitics', 'non-expert' groups started to criticise 'expert' risk decision-making. During the BSE crisis in the UK, public confidence in

governmental competence in dealing with food security decreased and consumers demanded more transparency and traceability regarding how their food was produced (Feindt & Kleinschmit, 2011; Wales et al., 2006). The food safety crisis initiated new questions on how to protect consumer health and food safety. The EU started to move away from economic-oriented regulatory regimes towards regimes that could ensure consumer protection (and trust) in food chains (Alemanno, 2006). This turned the will of the consumer into a new important player in European markets. Food supply chains not only had to provide affordable food, but had to safeguard food safety and quality.

In the UK, the rise in the power of consumers accompanied the emergence of the new supply chain positions for retailers. Whereas consumers in the Post-War period largely bought their products from local groceries and food processor companies, retailers became the new food buying locations for consumers during the 1980s. Manufacturing products (butter, milk powder, cream) increased in popularity while consumer expectations in relation to dietary issues in relation to animal fats changed production expectations of milk (Empson 1998). In the UK liquid milk market, retailers started to compete with home delivery systems and milk processors through competitive pricing (Banks & Marsden 1997). In the 1980s supermarkets only sold 10% of total milk, by the 1990s this had become 50% and would become nearly 100% in the years that followed (Banks & Marsden, 1997, p. 389). Consumer-oriented retailers implemented milk consumer demands around their own particular interests (Grant 2012). Together with deregulatory actions, the emergence of consumer power and new supply chain positions would contribute to the redefinition of milk safety, quality and its standardising practices.

### **Food supply chain responsibilities**

The BSE food crisis was not only a matter of how to control public health in food safety issues, but also how to maintain consumer trust in the food safety of the European single market. In 2000, the EU published the 'White Paper on Food Safety', which formulated the standardisation of food safety as a process that should take place at food supply chain level. To guarantee principles of food safety at every stage of production, the 'White Paper of Food Safety' introduced policy based on the concept of 'from producer to the end product' or 'farm to table' (2000, p.3). This gave feed manufacturers, farmers and food operators the primary responsibility for food safety (European Commission, 2000). In this context the role of 'competent authorities' was to monitor and enforce this responsibility through the operation of 'national surveillance and control systems' (European Commission, 2000, p. 8). The 'White



Paper on Food Safety’ and its recommendations created a new role for European food supply chains and how to govern their production.

To safeguard consumers, Europe further institutionalised food safety at the European level through a new set of laws: The European General Food Law Regulation (EC) No 178/2002; Regulation (EC) No 882/2004 ‘Official Feed and Controls Regulation’ which sets out responsibilities of both national and EU inspectors; Regulation (EC) No 853/2004 on specific hygiene rules for food of animal origin, and; Regulation (EC) No 854/2004 which lays down specific rules for the organisation of official controls on products of animal origin intended for human consumption. These regulations laid out the principles and obligations that needed to be implemented in the ‘farm to table’ policies, such as adherence to ‘good manufacturing practices’ (GMP) and ‘hazard analysis critical control points’ (HACCP) (European Commission 2002, p. 9). The HACCP system has become the internationally recognized ‘farm to table’ safety mechanism that assures food safety, food handling, processing and retail sales (FSA, 2017). In accordance with Regulation (EC) No 178/2002, consumer interests became represented through the establishment of The European Food Safety Authority (EFSA). EFSA was established as an independent ‘expert’ authority responsible for performing risk *assessments* on issues related to food safety at a European level, independent from production-oriented policies of the CAP.

In accordance with the above legislation, the risk *management* of issues became the responsibility of Member Governments and food chains. Food supply chains were delegated key responsibilities in the management and policing of the food system.

### 5.3 Dairy de-regulation in the UK: the emergence of milk contracts

As a consequence of Europe’s climate of food governance, the UK dairy industry underwent significant changes. EU objections to the monopoly position of the MMB, the widespread dissatisfaction of UK farmers with the low milk price they received from the MMB, dairy industry objections to the operations of a state-producer monopoly, and the high running costs of the MMB, all led to the abolition of the MMB in the UK Agricultural Act of 1993. The UK dairy industry effectively entered a free market (Banks & Marsden, 1997).

At first, a successor body – Milk Marque – was established. This farmer-owned voluntary co-operative initially collected and sold around 50 per cent of milk supplies across the UK (Banks

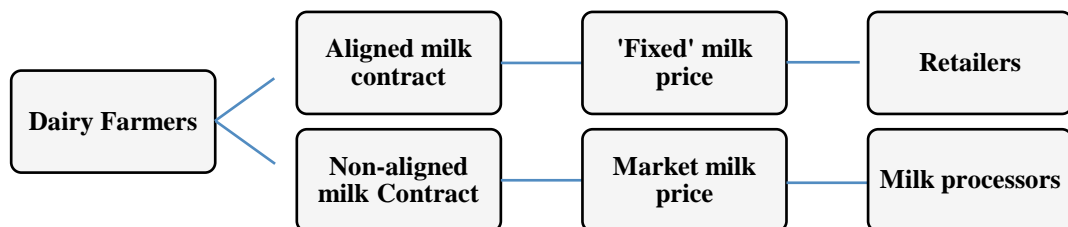
and Marsden 1997). Alternatively, farmers were able to contract with dairy processors directly rather than selling their milk to a broker. Importantly, with supplies no longer guaranteed due to the milk quotas and with prices no longer being fixed, this created intense competition between all milk purchasers (Bates & Pattison, 1997). To secure milk supply, processors started to establish their own 'milkpools' by contracting farmers through *non-aligned milk contracts* (Franks & Hauser, 2012). To attract suppliers away from Milk Marque, many milk processors started to offer a fixed price premium over the Milk Marque price. The free market dynamics reflected the average milk price paid by dairy companies (pence per litre), which rose from 22.5 in 1992-1993 to 26.0 in 1994-1995 (Franks & Hauser, 2012).

However, the pricing of milk became less transparent. The market milk price of dairy processors was partly based on the market value of their product mix (liquid, commodity, value added products) (Banks & Marsden, 1997). By breaking with Milk Marque's pricing schemes, processor milk contracts started to financially incentivise milk quality parameters. Milk quality parameters such as production characteristics (protein and butterfat), stockmanship standards and animal welfare standards started to define production conditions. This enabled milk processors to source milk that more closely met their quality standards. Milk prices were also influenced by their competitors' price and seasonal influences. In addition, the milk price was used to regulate the annual fluctuations in milk production effectively encouraging or discouraging milk supply in line with the nature of the fluctuation. Finally, milk quality and transport charges started to impact upon the final milk price (Banks & Marsden, 1997).

Nevertheless, the milk pricing schemes offered by the processors attracted milk producers, with membership of Milk Marque gradually starting to fall (Franks and Hauser 2010). Complaints about Milk Marque's potential ability to regulate milk prices because of its market share were increasing. Consequently, Milk Marque was disbanded in 2000 into three independent farmer owned, co-operatives with the possibility to purchase processing capacity. It was believed this would create a more competitive market for producers and processors. By 2009, 137 milk buyers/processors were registered (Franks and Hauser 2010), with different milk processor supply contracts and pricing mechanisms. More than 50 types of contracts could be observed with milk price ranges from 28.58 to 24.25 pence per litre (Franks and Hauser 2010).

In the meantime, liquid milk attained the highest food sales value in supermarkets, making it an important strategic product in retailers ‘market baskets’<sup>7</sup> (Mylan, Geels, Gee, McMeekin, & Foster, 2015). Retailers started to contract milk producers directly through *aligned milk contracts*, which meant farmers went on additional milk contracts with retailers. Milk producers still needed to meet milk processors standards but they had to meet an additional set of retailer standards for which they received a ‘fixed’ milk price from the retailer. These dedicated supply chains allowed retailers to increase value by selling milk under their own-label tailored to the demand of consumers (Mylan et al., 2015). Through additional standards in terms of animal welfare, disease status, husbandry and environmental footprints, retailers add value to their dairy products in a highly competitive milk market. To milk producers, the long turn relationships with fixed milk prices offered economic security and opportunities for farmers to invest.

By 2012, about one-quarter of the UK dairy farmers held supermarket milk contracts, enabling them to improve husbandry and distinguish themselves from other dairy farmers (Costa-Font & Revoredo-Giha, 2018). De-regulation resulted in two main types of contractual relationships in the dairy industry, presented in figure 5.1. Milk safety and milk quality demands will be discussed in the following paragraphs.



**Fig 5.1:** Contractual relationships in the UK dairy supply chain

<sup>7</sup> With modern retail industry being characterized by a customer-centric nature, retailers use market basket analysis to understand consumer behaviour. It identifies consumer behaviour, buying patterns, and relationships between products and content delivered by the retailer inside the store or online. It allows retailers to understand the size, quantity, and value of the customers’ market basket to understand how products are purchased. Liquid milk in the UK is one of the core?? Not sure this sentence is finished?

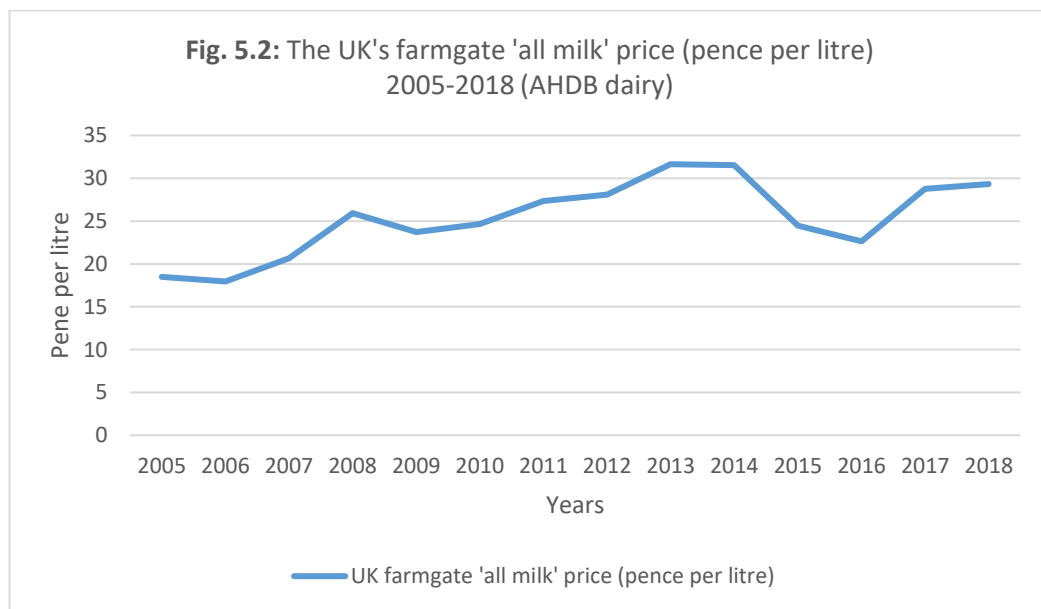
## 5.4 Milk price fluctuations since de-regulation and the dubious milk pricing mechanisms of milk contracts

The true cost of milk is not about how much milk costs in the shops but how much it costs for farmers to produce milk and for how much they can sell their milk on the wholesale market or 'farm gate' price. The UK Farm-gate milk price is the average milk prices per litre (net of delivery charges) paid by dairies for all milk purchased in the month in England, Wales, Northern Ireland and Scotland (AHDB Dairy, 2019). Defra monitors and produces the monthly Farm-gate milk price to follow national and international milk market trends (Department for Environment, Food & Rural Affairs, 2019). Evaluating trends since 1994, the period between 1994 and 2002 showed a fluctuation in milk prices due to the uncertainty of the milk markets after de-regulation (Franks & Hauser, 2012). Competitive markets and uncertainties related to supplies increased the milk price. It subsequently dropped; stabilising between 2002-2007 with settlement of UK and international markets. A peak in price in 2007 was the result of a spike in international prices due to imbalance between supply and demand. The low average milk price between 2000 and 2009 led to a decline in British milk production because the farm gate milk prices were lower than milk production costs. Together with an increased international demand for UK produced milk, due to a weakened sterling, the milk price went up again until 2013 (Franks & Hauser, 2012).

With milk contracts defining the milk prices, their pricing mechanisms became a topic of debate in dairy communities. To reduce the milk price inequalities created through the milk contracts, dairy farmers and processing companies in the UK agreed in 2012 upon the 'Dairy Industry Voluntary Code of Best Practice on Contractual Relationships between milk buyer and supplier' (the Dairy code) (Dairy UK, NFU, & NFU Scotland, 2012). The Code was designed to provide transparency and confidence in the milk contract between milk processor and milk producer. It discussed what information on pricing mechanism and price variation processors should provide to milk producers (Downing, 2016). While adherence to the code is voluntarily, it was intended to drive best practice and was meant to be adopted across the dairy supply chain (Dairy UK et al., 2012). But being voluntary, milk buyers would only adopt the code if all milk buyers were signed up to the terms. Milk contracts currently remain confidential, preventing detailed comparisons between the contracts besides the prices paid (Costa-Font and Revoredo-Giha 2017).

Due to a price fall of 25% over the year 2014, many UK dairy farmers were being forced out of business, with the costs for farmers to produce milk being higher than the price they receive

for their raw milk (Ruddick, 2015). The drop in milk price in the UK resulted from a number of national and international factors coinciding: UK retailer price wars; an international decline in milk demand, particularly from China and Russia (a Russian ban on European meat, fish and dairy products due to geo-political struggles), and oversupply of milk and milk products in Europe resulted in a reduction in the UK milk price (Downing, 2016). The market became under even more pressure when the EU abolished its milk quota on the 31<sup>st</sup> of March 2015 to allow milk sectors to operate closer to free market conditions. The average farm-gate price for June 2015 was 24.46 pence per litre – the lowest price paid for five years, which resulted in UK dairy farmer strikes in 2015 (BBC, 2015b, 2015a). The Farmgate milk prices dropped even lower in 2016, resulting in farmers protesting over the summer of 2016, with cows paraded through the aisles of an Asda store in Stafford, in the West Midlands (Ruddick, 2015). In 2016, as farmers were performing below the cost-production of milk, the former NFU dairy board chairman Michael Oakes called for milk buyers to pass gains in the wholesale markets to their supplying farmers (NFU, 2016a). Price indicators were showing prices should be between 25-30 pence per litre, while most of the non-aligned prices were around 20ppl. Since then, the farm gate ‘all milk’ price has increased to an average of 29.34 over the year 2018 (see figure 5.2).

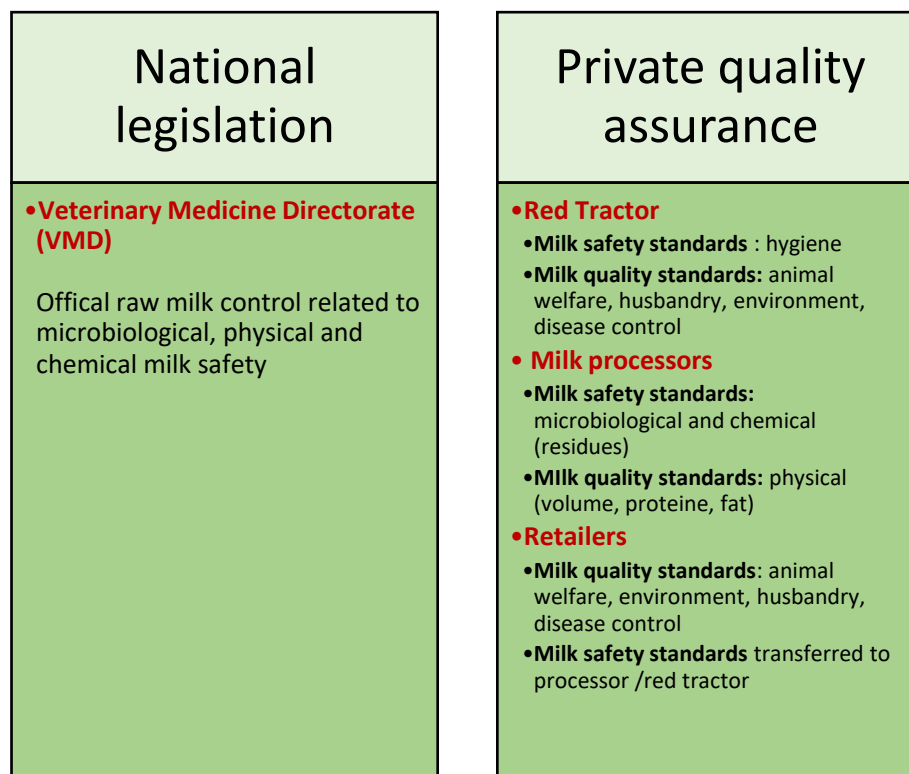


NFU estimated in 2016 that the price of production for milk is around 30 ppl (Downing, 2016, p. 7). To evaluate how the farm gate milk price reflects the actual costs of milk production, AHDB regularly publishes estimates of how much it costs for producers to produce milk, in pence per litre. The average GB farmgate ‘all milk’ price was 30.55 ppl in December 2018

(AHDB Dairy, 2019). Hence, tight margins exist today between the cost of production and milk prices locking farmers in their local realities. Importantly, with liquid milk as one of the central products for retailers, this thesis has focussed on the liquid milk contracts. As will become clear in the next Chapter, milk price shapes farmers response to dairy supply chain quality standards.

## 5.5 Milk safety and quality regulation in the UK

The former paragraphs have established the tensions that exist between milk producers, milk contracts, milk prices, milk processors, retailers and consumers. In order to understand how dairy supply chain members respond to responsible AB-use, it is important to define milk safety and milk quality and the mechanisms and responsibilities for assuring safety and quality. In what follows, I will first introduce governmental and food supply chain responsibilities in terms of milk safety and quality, and how milk safety and quality is defined by the different responsible bodies. Figure 5.3 presents a schematic oversight of the paragraphs that follow.



**Fig. 5.3:** Regulation of milk safety and milk quality in the UK dairy industry

### 5.5.1 National Responsibilities

In the context of the dairy industry, EU directives require that farms and processing plants undertake general hygiene measures related to the microbiological, physical and chemical hazards (Bailey & Garforth, 2014). Regulation (EC) No 854/2004 and Regulation (EC) No 853/2004 require occasional official controls on milk production holdings for raw milk and colostrum to verify compliance with plate count, somatic cell count and residues of AB substances. Member States can take samples from raw milk either at farm level from the collection tank or at the level of the dairy industry before the bulk tank is discharged. In the UK, the VMD controls milk samples from milk bulk tanks on farms with microbiological, physical and chemical parameters. The sampling is carried out by the Animal and Plant Health Agency (APHA) and tested by Fera Science Ltd, UK's National Reference Laboratory for veterinary medicines residues (VMD, 2016a). The VMD publishes bi-monthly the results of the controls, available online (VMD, 2018). Part of the VMD's residue control program is the screening for AB residues to which I next turn.

### 5.5.2 Milk residues and their Maximum Residue Levels

Medicines used in food animals can leave traces of medicine residues in animal derived products. To protect human health against medicine residues in animal products, AB withdrawal periods have been established for each AB product and their application in food animals. The AB withdrawal period is the statutory period that should elapse between the last day of AB treatment until the moment the food-producing animal enters into the food supply chain (FSA, 2016). During the medicine withdrawal period, food-producing animals or their products cannot be used for human consumption. To ensure the withdrawal period of medicines used in food-producing animals are respected, regulatory authorities have established medicine Maximum Residue Limits (MRLs). The MRL is an official EU standard and is designed to protect the health of the European consumer by ensuring that food animal products (e.g. meat, milk, eggs) are not placed in markets if they contain residues that exceed regulated limits residues (FSA, 2016). MRL thresholds of ABs are meant to separate AB 'safe' from AB 'unsafe' animal products. The MRLs of ABs in foodstuffs of animal origin are detailed in Regulation (EC) No 37/2010. In addition, Regulation (EC) No 853/2004 contains legal European requirements on how to control medicine residues in food supply chains, at national and supply chain level.

Farmers must make the results of all AB testing they undertake available for inspection by the competent authority under request and keep records of ABs administered to their animals for 5 years (FSA, 2016). The FSA publishes AB residue guidelines for milk producers, milk

purchasers and milk to help prevent AB residues in *raw* milk from entering the food chain (FSA, 2018). The position of Regulation (EC) No 854/2004 and Regulation (EC) No 853/2004 however is that the main responsibility of residue management lies with the food business operators, who need to test milk at various points from farm to fork to control MRL levels of AB. This responsibility is milk processor driven.

### 5.5.3 Red Tractor Private National Assurance:

To unify transparency across Farm Assurance Schemes, the British food industry introduced the ‘British Farm Standard’ known as the Red Tractor symbol (Figure 5.4).



**Fig 5.4:** Red Tractor Symbol

Established in 2000 as a not for profit company, Red Tractor is owned, funded and run by the food industry and has become Britain’s biggest farm assurance scheme across livestock species (together with Lion Eggs in the poultry industry, covering 90% of UK eggs). Red tractor as an organisation is represented by experts from the farming and food industry and is the only scheme in the UK that ensures food traceability from farm-to-pack. The income of Red Tractor comes from assured members, food businesses who pay to use the Red Tractor consumer logo on food they pack. The Red Tractor label stands for ‘basic’ production standards covering the harmonisation of animal welfare, food safety, traceability and environmental protection across food producers. In the Dairy Red Tractor Farm Assurance Scheme, safety standards refer to hygiene and equipment; residue safety is the responsibility of the VMD and milk processors (as will be discussed in the next paragraphs) (Red Tractor Assurance, 2017). The Red Tractor standards are produced in consultation with customers, farmer representatives and the wider industry to make them representative of the industry and



accountable to consumers. Red Tractor standards normally have a three-year revision cycle and can only be amended after consensus among industry members. Importantly, Red Tractor standards are species- or product-specific and involve a set of standards in accordance with the demands of processors and/or retailers (Bailey & Garforth, 2014). At the dairy sector level, 95 % of the UK dairy producers operate through the Dairy Red Tractor Assurance Scheme as all major milk processors require that their milk producers are Red Tractor farm assured (Bailey & Garforth, 2014).

#### 5.5.4 Milk processor responsibilities

##### The UK milk processor structure

Roughly 79% of milk processed in the UK is controlled by 9 companies, which account for 2% of all milk processing companies. The UK distribution of Dairy Companies by product is presented in Table 5.2.

**Table 5.2:** Total amount of UK dairy milk processors in 2015, specified by commodity (AHDB Dairy, 2017c)

2015 Specified commodity	UK Distribution of Dairy Companies by Product	
	Companies Processing Milk	Volume of annual Milk Intake
	Number	Thousand Tonnes
Liquid milk	242	6490
Cheese	95	295
Butter	24	143

Approximately 90% of the UK's liquid milk output is controlled by 7 companies (AHDB Dairy, 2017c). Muller and Arla are the two dominant players, each having a third of the total milk intake. The other 20% is divided between milk processors such as First milk, Medina, Tomlinsons Dairy Crest and Meadow Foods. The remaining 10% is accounted for by a large number of small milk processors. Milk processors set standards in the non-aligned milk contracts in relation to milk quality/composition (somatic cell count, milk solids such as fat-protein-lactose and mastitis pathogens such as *E.-coli's*, *staphylococcus*) and milk safety (residue control). In return, farmers receive a volatile milk price that milk processors define through costs, profits and the market milk price.

### **Milk safety: medicine residue control**

The VMD testing regimes are complemented with sampling and testing regimes of the individual food business operators. At farm level, farmers need to consider AB withdrawal times when they use ABs to ensure raw milk from *individual* animals under treatment does not enter into the milk supply chain. Through their milk contracts, they are obliged to ensure that their milk is free from ABs (Interview Milk Processor 1). They can use farm test kits to test if the raw milk of a cow under treatment is ‘safe’ to be deposited in the milk bulk tank of the farm. Milk buyers, such as the milk processors, must have sufficient control mechanisms in place to test raw milk for the presence of milk residues above MRL level before they can process the milk (Interview Livestock organisation 4). It is up to the food business operators to determine sampling frequency on a risk basis, with reference to specific requirements in Regulation (EC) No 853/2004. To address levels of control at farm level and processor level, milk processors have two control mechanisms in place to manage the risk of milk residues.

The first mechanism is indirectly paid for by farmers through their ‘*quality assurance program*’ (quality standards), which is specific to the milk processor’s milk contract (Interview Livestock organisation 4). When milk is collected at the farm by a processor’s milk road tanker, a sample of the farm milk bulk tank will be taken which will be sent to the national milk laboratory (NML). The NML will test the milk sample for butterfat and protein if this is part of the payment scheme, and test it once a week using the *standard Delvo test*<sup>8</sup>. Secondly, milk processors will have their own ‘*quality control program*’ in place which contains a sampling and testing regime based on risk assessments of their dairy supply chains. This is financed by the milk processors themselves (Interview Livestock organisation 4). As part of their ‘quality control program’, milk processors will test every milk road tanker that arrives at their plant, using an Immune-receptor test such as the *quick SNAP Beta-Lactam test* type (Interview Veterinary surgeon 21). This test is cheaper but more restricted in residue testing than the standard Delvo test. The milk from the road tankers is emptied into the processor’s milk silos which will be AB tested on a frequency determined by the risk assessment of the milk processor (FSA, 2015).

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<sup>8</sup> Two types of tests circulate that can be used to test milk for ABs (FSA 2015, p.7).

**1. Immune-receptor tests:** their spectrum of detection is normally limited but they give a positive or negative result within 5-10 minutes;

**2. Microbial inhibitor tests:** they detect a wider range of antimicrobial substances, including  $\beta$ -lactams, and give a result within 3 hours or less. The Delvo test is the most well-known global dairy standard microbial inhibitor test used by farmers, dairies and milk control laboratories that tests for a broad spectrum of AB residues. Importantly, the test comes out either positive or negative, but does not specify the type of failure.

Where milk fails the testing, the failure can be attributed to individual farms according to the records which link the samples of milk to the farms from which they were collected with the tanker which transported the milk. Although the testing and follow up procedures (e.g. evaluating the farm) are paid for by the milk processor, the costs of the loss of the milk will be to the farmer who has a positive result. The testing procedures at farm bulk tank level, milk tank level and processor silo level should allow 'full' transparency of the milk supply chain's responsibility to produce residue 'safe' milk products (Interview Livestock organisation 4). The FSA in England and Wales (FSA, 2015, p. 13) must be notified by milk purchasers and milk processors in case of a milk residue failure as soon as possible and at least on a monthly basis. The FSA will follow up actions undertaken by the milk purchaser/processors, including monitoring if milk is disposed correctly according to regulation (FSA, 2015, p. 13).

### **Milk quality/composition responsibilities**

Milk processors 'measure' milkfat, protein, bulk milk cell count and bacteria count in order to define the *quality and composition of their milk* (Interview Milk processor 1). These parameters will influence the destination of the dairy product (liquid milk, cheese, butter, yoghurt and other products). Farmers receive a milk price in accordance with the quality/composition of the milk he/she produces, defined by the milk payment scheme in their milk contract. If the milk of producers does not meet the quality and composition standards, it is rejected and the milk producer will not get paid. This enables milk processors to use their milk payment schemes to 'govern' farmers in delivering a certain quality and composition of milk.

In October 2015 milk processor Arla introduced in the UK their own quality assurance scheme, 'Arlagården', on top of the Red Tractor assurance (Arla, 2015). This private farm assurance scheme, defined by Arla in cooperation with Red Tractor, demands that farmers comply with additional milk quality standards (Arla, 2015). These standards focus on milk quality, food safety, and animal welfare and need to be met by the 2500 UK dairy farmers who supply Arla. All 12,700 Arla farmers in Denmark, Sweden, Germany, Belgium and Luxembourg are now assessed to the same standards (Arla, 2015). In creating standards over and above the red tractor scheme Arla has differentiated itself from other processors in the market.

### **5.5.5 Retailer quality standards**

As discussed earlier, certain retailers have started to contract farmers directly. This means retailers pay their 'aligned milk pool', a fixed milk price for on average 6 months for which farmers must comply with retailer production standards. These milk 'quality' standards focus

on animal welfare, environmental footprints, sustainability, and disease status. Milk processors have, in this situation, the task of ‘toll-manufacturer’ and will be paid the processing costs of the raw milk. Milk processors remain in this case responsible for the safety (chemical, microbiological) and composition (physical) of raw milk.

Retailers will negotiate milk prices directly with their aligned farmers while negotiating processing costs with the milk processors they have contracts with (Interview Retailer 1 and Retailer 2). The fixed milk price covers labour, materials, supplies, equipment and overheads. In return, farmers receive security in milk price and income. Through this mechanism, retailers aim to ‘control’ the production standards while incentivising farmers by offering a fixed milk price in return. The disadvantages of aligned contracts for retailers are that they have to pay their farmers a higher milk price than competitors; and for farmers they can miss out on profit when global milk market prices increase. Thus, aligned contracts reduce exposure to market volatility but come with more stringent conditions attached to the contract. Independent third parties are involved in managing cost-production price calculations and in negotiations between producers and processors. The independent third party will try to set a cost-production price that reflects the cost of production to dairy farmers and is average for the sector. The liquid milk from their aligned pool of milk producers will be sold under a retailer owned label, which reflects the retailers’ production standards laid out in the contract (Interview Retailer 1 and Retailer 2).

An example of a retailer-producer agreement is the Tesco Sustainable Dairy Group (TSDG), which was set up in 2007 and comprises around 600 farmers who supply Tesco with own-brand milk (Tesco, 2018). A cost-production price is set in collaboration with farmers and set for 6 months, independent from the retailer price for milk. Another example is the Sainsbury’s Dairy Development Group (SDDG), also established in 2007, which comprises approximately 270 dairy farmers (Sainsbury, n.d.). SDDG members are assessed and benchmarked against health and welfare outcome data in order to drive improvement. SDDG also uses a cost of production model to provide milk price stability and promise a volume of guaranteed supply for Sainsbury’s (Sainsbury, n.d.). Other retailers who offer ‘aligned’ contracts include Waitrose, Morrisons, M&S, Asda and Co-op (NFU, 2016b). Middle ground retailers such as Aldi, Lidl and Budgens do not have their own milk pools and buy milk from processors instead directly from farmers. The price they pay indirectly to farmers follows the market price and does not guarantee more than the cost of production. Their milk will be farm assured against the standards of the milk processor, which will be Red Tractor Dairy Farm Assurance in 95% of the cases (Red Tractor Scheme, 2017).

## 5.6 Discussion

This Chapter has provided details of how food supply chains have been institutionalised over time as the responsible actors need to ensure food quality *and* safety to consumers, from farm-to-table. This process of institutionalisation was multifaceted and took place at national and European level. Food safety crises during the 1980-1990s co-produced new consumer profiles that demanded new control mechanisms to ensure food safety. At the same time, European integration of agricultural markets in a single market produced new ideas on how to govern food safety and food quality across member States. Neo-liberal agricultural regimes emerged which made food supply chains responsible to produce ‘safe’ food products against high quality control standards. In a competitive, ‘free’ European food market, food safety and quality merged under the ‘food quality’ umbrella. Food safety became more than ensuring ‘safe food’; it became entangled with the ‘food quality’ marketing strategies of private supply chains. Consumer demands are increasingly dictating the quality standards retailers define and impose back up the food chain to suppliers.

In dairy, milk contracts, milk production standards and milk prices, have not only become tools to standardise milk production and processing procedures in milk supply chains; they have become part of the commercial strategies of milk processors and retailers. More than 50 different milk contracts currently shape how farmers manage their production units and how milk quality becomes ‘standardised’ across the dairy industry. The Red Tractor dairy scheme serves as a milk safety and quality label, through which retailers and milk processors can choose whether they want to add quality parameters. This raises questions about the responsibility the dairy supply chain has been given to drive responsible AB-use. How will dairy supply chain members respond to this responsibility? How do they include responsible AB-use as a public health responsibility in their economic futures? The following Chapter will explore how milk processors and retailers have responded to this responsibility and the consequences of this – both intended and unintended.

## **Chapter 6:**

Dairy antibiotic policies and their practices

## 6.1 Introduction

As discussed in Chapter 5, responsibilities in the UK dairy supply chains for milk safety and quality have been re-institutionalised over the decades. Important human actors (UK food safety authorities, consumers, retailers milk pools, milk processor cooperatives) and non-human actors (milk contracts, milk prices, milk quality standards, milk markets, farm assurance schemes, milk residues, AB tests) emerged that have influenced how the UK dairy supply chains have come to operate in competitive markets. I will explore these actors in this Chapter to understand their contribution to dairy AB decision-making, on paper and in practice. I will however first introduce how the UK dairy sector defines policies of antimicrobial governance in their sector.

## 6.2 Initial denial

In contrast with the pig and poultry industry, the UK dairy sector has only recently started to tackle AB-use. One explanation for this difference is that according to the UK-VARSS reports published over the last decade, the dairy and other food producing sectors use significantly less AB than the pig and poultry industry:

*“AMR and antibiotic usage in the dairy industry isn’t such a big problem. If you look at the use of drugs per kg of meat product or whatever, the big issue is the pig and poultry. They are the ones that are having a problem, and then behind them, comes the dairy sector and behind them comes the beef sector, so we are not actually responsible for a great deal of antibiotic usage.”* (Respondent Livestock organisation 4)

The British media have also played an important role in shaping the debate (Morris et al., 2016). The ‘factory farms’ in the pig and poultry industry were framed as the the most drugged-up food animal sectors (Fenton, 2016; Levitt, 2016). It was claimed that the overuse and misuse of ABs was driven by the need of intensive livestock systems to reduce their disease burden thereby reducing production costs. This negative media attention and the public concerns it produced pushed the UK pig and poultry sector to undertake *voluntary* action to reduce sector AB-use (Respondent Livestock organisation 1). Less intensive farming sectors escaped public scrutiny, which allowed those sectors to continue with their AB practices. Today, pig and poultry are considered by the agricultural industry as front runners in AB policy progress (Respondent Livestock organisation 1). They have established national electronic surveillance systems in which producers register their AB *usage* activities. They have significantly reduced overall AB sales *and* usage, banned or restricted prophylactic use and

restricted the use of HP-CIAs. The latest UK-VARSS report (2018) shows the differences in AB sales reduction between the livestock sectors over recent years (Table 6.1).

**Table 6.1:** The UK’s veterinary antimicrobial sales in tonnes of active ingredient per livestock species from 2012 to 2016

Species	2012	2013	2014	2015	2016
Pig and poultry	235	217	235	214	127
Cattle	14	14	13	14	18
Fish	2.1	0.8	2.4	0.7	1.6
Sheep	0.2	0.2	0.1	0.2	0.2

*Note: Adapted from UK-VARSS 2018*

### 6.3 The UK dairy sector action plan

The publication of the O’Neill reports (2015, 2016) challenged AB-use in both humans and animals. The UK livestock sectors were urged to make AB-use *transparent*, consider the *volume* of ABs used (prophylactic and growth promoting use) and the *types* of ABs used (HP-CIA’s) (O’Neill 2016). In 2017, the UK dairy sector highlighted the difficulties of establishing a ‘true and accurate picture’ of how ABs actually get used on farms, but stated it would work towards the collection of more ‘robust and representative’ AB usage data (RUMA, 2017, p. 14). In the RUMA task force report of 2017, they presented their Dairy Action Plan, in which they committed to a 20% reduction of overall AB-use while halving the use of HP-CIAs by 2020. The dairy sector identified 4 areas where there would be scope for change (RUMA, 2017):

- Focus 1: Overall reduction in the use of Highest Priority Critically Important ABs
- Focus 2: Selective dry cow therapy (SDCT)
- Focus 3: Pneumonia/respiratory issues in young stock
- Focus 4: Foot baths

In order to co-ordinate and implement the targets set in the Dairy Action Plan, the Dairy Antimicrobial Stewardship Group (DASG) was established in April 2017 by the NFU and



Dairy UK (UK's dairy trade organisation) (RUMA, 2017). DASG is the first dairy organisation to represent the whole industry. As the co-ordinating body, the DASG represents farming, processing, veterinary and supporting partners of the dairy industry. The DSAG was set up to reduce AB-use and increase transparency in the recording of dairy AB-use. To achieve this, DASG is responsible for designing AB data surveillance systems; dispersing knowledge on responsible AB-use; and aligning dairy industry members with their strategies. They identified the following key areas to deliver, promote and co-ordinate the Dairy Action Plan (RUMA, 2017):

- Improve data collection on antibiotic usage
- Antibiotic training
- Optimise on farm antibiotic use
- Supply chain initiatives
- Preventatives/alternatives
- Communication of strategies with farmers

In line with the UK Government's policy recommendations and RUMA's overarching policy framework, the dairy key areas are designed either to provide evidence-based information on AB usage activities or to transfer evidence-based knowledge to farmers and vets.

### 6.3.1 Statistical realities: surveillance systems

AB usage data collection serves as a central pillar in the strategy as it is believed this data will provide accurate oversight of use and qualify AB performance. It can therefore be used to stimulate the self-governance of farmer and veterinary AB-use:

*“Tools such as medicines audits allow us to better quantify the use of medicines on our farms and to compare changes we might make going forward, or to benchmark veterinary surgeons or farmers use of medicines against one another for continued comparison, as well as to prove what is possible [...] A great use of accurate records helps both farmers and veterinary surgeons to keep track of how they are doing and compare that to how others are doing, benchmarking can be very powerful” (Reyher, Barrett, & Tisdall, 2017, p. 67)*

To move from sales to usage data, dairy farmers are encouraged, at the moment, to record their AB usage data electronically by milk processors and retailers. A central co-ordinating data hub will be the next step forward (RUMA 2017).

### 6.3.2 ‘Evidence-based’ knowledge programmes and herd health informants

The vet/farmer relationship is considered as paramount to drive responsible AB-use by the Dairy Action Plan (RUMA, 2017, p. 15). To strengthen evidence-based communication and decision-making between both professions, several knowledge tools have been implemented. AHDB dairy, RABDF<sup>9</sup> dairy and Dairy UK are the organisations that provide dairy producers with voluntary programmes to optimise AB-use and herd health management. At the veterinary level, the British Cattle Veterinary Association (BCVA) promotes responsible AB-use of medicines to vets (BCVA, 2016). To control and/or eradicate endemic diseases, the BVCA runs a BVD<sup>10</sup> and Johne’s<sup>11</sup> training program for vets (RUMA, 2017, p. 16). According to the UK dairy sector (see the next quote), these AB training programmes are trusted to transfer evidence-based AB knowledge to farmers and vets and stimulate the self-governance of responsible AB-use (RUMA, 2017, p. 16).

*“Raising the awareness of the issues has already triggered a willing and strong response from the sector; with many farmers attending workshops and courses to improve their own knowledge; they are going back to basics to learn which antibiotics are classified as HP-CIAs and to start asking the ‘why’ question. This has led them to look at their protocols and infrastructure on farm and develop strong working relations with their vets, which will be fundamental in the delivery of these reductions [...] Through proposed farmer and vet training packages, as well as academic syllabuses, the next generation can be educated to ensure that both understanding and responsible antibiotic use of antibioticss becomes second nature”*

### 6.3.3 Dairy supply chain responsibilities: driving change

The O’Neill report of 2016 requested that food supply chains be transparent in their AB practices, to ‘enable consumers to make more informed purchase decisions’ (p. 26). Retailers, milk processors and the industry-led Red Tractor Dairy Farm Assurance Scheme are responsible for driving change in AB usage across their supply chains and providing transparency of these activities. Dairy supply chains are expected to work with their farmers to reduce HP-CIA use, to implement Selective Dry Cow Therapy (SDCT) strategies and to deliver transparency in AB usage activities of their farmer pools (Interview Retailer 2). Their

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<sup>9</sup> RABDF is a UK charity focused on the needs of milk producers. They have relationships up and down the whole supply chain focusing on four areas: 1. Influencing and lobbying, developing young talent, improving business resilience and identifying and showcasing ground-breaking innovation.

<sup>10</sup> BVD (Bovine Viral Diarrhoea) is an endemic viral disease in the UK caused by the pestivirus which infects cattle but can also infects sheep and other ruminants (AHDB Dairy, n.d.).

<sup>11</sup> Johne’s Disease or Paratuberculosis is a chronic, contagious bacterial disease of the intestinal tract caused by *Mycobacterium avium* subsp paratuberculosis and can be found in sheep and cattle (mostly dairy) and other ruminants (AHDB Dairy, n.d.-b).

activities will be discussed more in depth in the following sections.

## 6.4 Dairy antibiotic policies and the practices of the policies as actor-network activity

The UK Dairy Action plan and its expectations were designed and published during the course of my fieldwork. Dairy supply chain actors had already started to implement AB policies in response to the O'Neill reports (2015, 2016) and the government response report to O'Neill (Department of Health 2016). Importantly, following the recommendations of the 'Alliance', the dairy sector used technocratic policy instruments, such as measurement and evidence-based training programmes, to drive responsible AB-use by UK dairy farmers. Dairy supply chain members were therefore being made responsible for implementing these measures and delivering evidence of their success. What dairy sector actors and their policies have in common is that they consider AB-use by farmers and vets as a behavioural problem, which needs to be rationalised. This reasoning positions farmers and vets as 'free' autonomous actors who need to be standardised in their decision-making from their social, economic, and/or political-ecological context. Consequently, farmers and vets are the targets of AB policies.

Questioning the autonomy of farmer decision-making, Gray & Gibson (2013) have explored how farmers incorporate new technologies into their daily practices. Instead of focusing on individual farmer behaviour as a site of interest, they use Latour 's (2005) Actor Network Theory (ANT) to study how the agricultural relations of farmers influence their decision-making. Farmer's agricultural networks were examined as a heterogeneous mix of human (off-farm experts, peers) and nonhuman (fertilizers, technologies, farm equipment, pesticides, farm credits) components. The authors show that the configuration of heterogeneous agricultural actors both expands and constrains farmer AB decision-making (Gray & Gibson, 2013). Following Gray and Gibson (2013), the next two sections in this Chapter and Chapter 7 will demonstrate how AB policy decisions and their practices take place as an agricultural network activity. Which actors matter in dairy supply chain networks? What is at stake? How does this shape dairy supply chain AB policies and their practices? These questions will be used to trace how AB decision making across dairy sector actors is either constrained or expanded by their agricultural networks. The intended and unintended effects or 'overflows' of dairy agricultural network activities will be furthermore discussed to evaluate the public health and environmental impact of dairy policies.

## 6.5 Taming antibiotic milk residues: milk processors battle to deliver ‘safe’ milk

### 6.5.1 Risky antibiotic residues as ‘matter of concern’

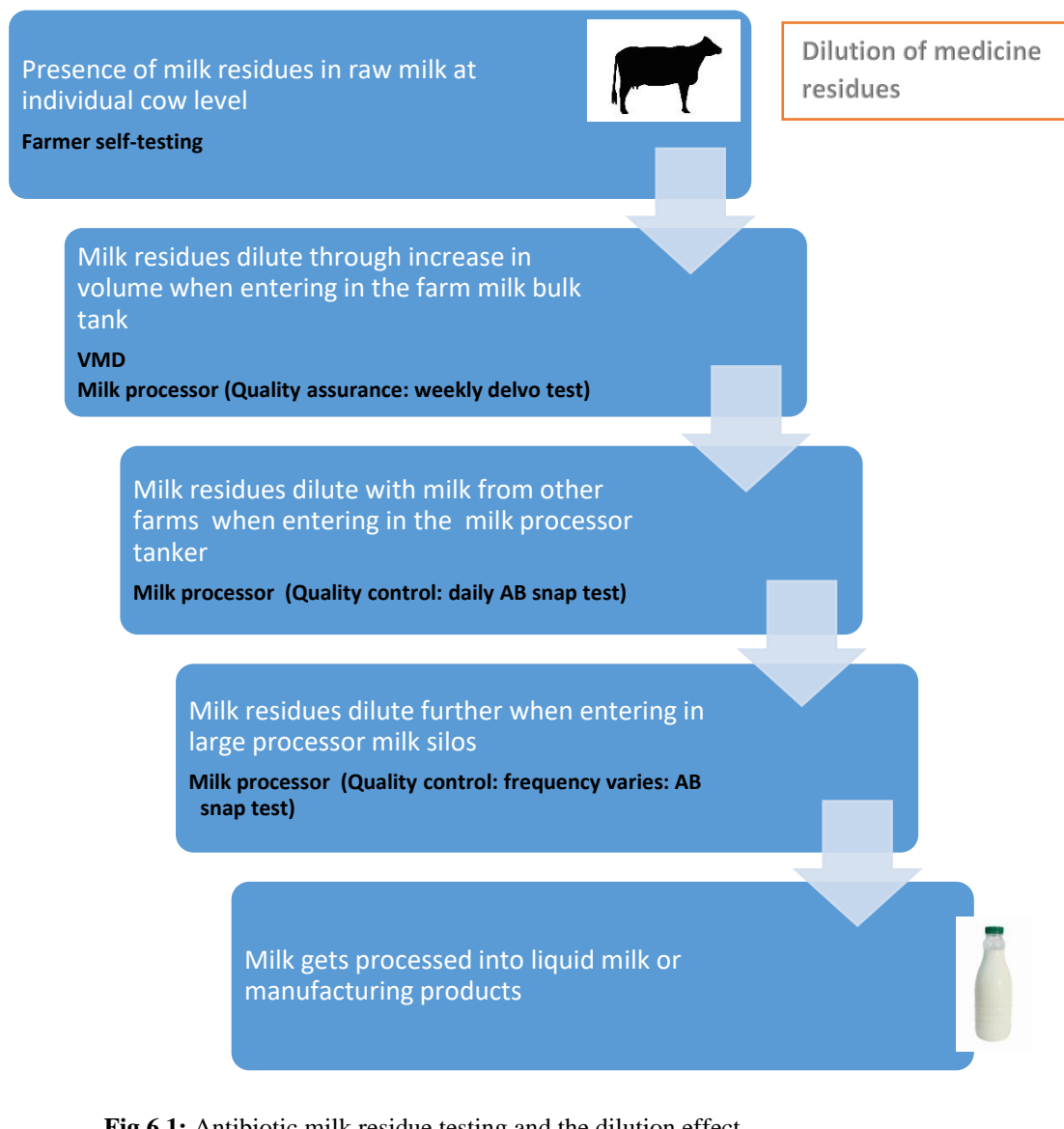
As will become clear, AB residues are ‘co-producing’ milk processors AB strategies and farmers’ AB practices.

*“There are two elements; you have responsible antibiotic use. This is the sexy subject, you know, everyone is interested in that thing, whatever that means. And then you have the residue management side of it, which is traditionally the area that I need to manage and have concern over. And this is the one that people don’t like to talk about and it becomes quite dry and boring in effect. But actually, the two are inter-related.”* (Milk processor 2)

Evaluating the VMD national residue surveillance schemes over 2015, 2016 and 2017, they reveal there have been only 3 non-compliant samples/AB milk residue failures at farm bulk tank level of over 4300 tested farms. According to NOAH (NOAH, n.d.), farmers and vets have an excellent track record of ensuring food is free from medicine residues. However, milk processor test results divert from the VMD results.

*“The numbers of failures we get here as a company is about, let’s say 33 a month, or something like that across all our farms.”* (Milk processor 2)

An explanation for the difference is the higher frequency in sampling and the number of farms that milk processors screen. However, the most important indicator to evaluate whether farmers are compliant to MRL levels is the control point of sampling. This will determine whether a medicine residue is detectable or not. The VMD and milk processors start testing at *farm milk bulk tank* level (FSA, 2015). The farmer is responsible for ensuring that the raw milk of the *individual* cow is safe before it enters the milk bulk tank (FSA, 2015). But as the milk in the tanker travels from farm to farm and to the milk processor plant, it gets diluted with milk from other cows. A similar effect happens with milk residues, which get diluted when travelling from the cow to end product (see Figure 6.1).



**Fig 6.1:** Antibiotic milk residue testing and the dilution effect

The dilution effect can cause milk samples to test in accordance with their MRL levels at farm milk bulk tank level, even when they may exceed MRL level at an individual cow level.

*“So natural dilution, it is not deliberate dilution but it is an operational consequence. We can’t dilute out residues deliberately, it will be illegal to do that.” (Milk processor 2)*

*“If you buy milk on supermarket shelves, because it is diluted out with lots of other farms, the milk is almost certainly going to have residues below the MRL for everything.” (Veterinary surgeon 21)*

From a food safety perspective, the EU MRL legislation requests that products which tested MRL positive at *individual cow level* should be recalled and destroyed (FSA, 2015). However, when milk processors receive a positive test result the milk from this farm has often already been processed and is on its way to the supermarkets. Although the milk at processor level can test below MRL levels and is as such considered as ‘safe’, milk processors are officially still in breach of the EU MRL law. Recalling every positive result at farm milk bulk tank level would be a logistic and economic nightmare resulting in a large number of dairy products in UK supermarkets being destroyed. In the past, to protect dairy supply chains, the FSA has previously tolerated the ‘dilution-effect’ of milk residues by turning ‘a blind eye to it’ (Interview Veterinary surgeon 21).

The recent international politicisation of the public health risks of AB-use in food animals has however renewed attention on how the UK dairy industry manages AB residues. The FSA has now begun to exert pressure on milk processors to increase their milk residue controls (Interview Veterinary surgeon 21). This has turned milk residues into a matter of concern to milk buyers, not only from a milk safety perspective, but also financially: the costs milk processors spend to investigate milk failures are significant (Interview Milk processor 2).

*“What the milk buyers do, they always investigate a bulk tank failure and they spend huge resources doing that.”* (Veterinary surgeon 21)

More stringent controls on milk residues mean a need for stricter controls on milk failures. For milk processors, responsible AB-use by farmers can reduce the risk of AB residues entering the milk supply chain. Hence, the milk processors are working with two responsibilities in the design of their AB policies: responsible AB-use and milk residues. In what follows, responsible AB-use policies by some of the bigger milk processor companies are discussed, explaining the focus on SDCT and Dairy processors use of Red Tractor. Next, milk residue policies will be discussed in the following order: farmer training, milk penalties and milk self-testing. The overflows of the former strategies will be finally discussed.

### 6.5.2 Selective Dry Cow Therapy (SDCT)

The ‘dry cow period’ is the part of the cow’s lactation cycle during which the cow’s milk production is stopped for at least 40 days until the next parturition (AHDB Dairy, 2017b). This allows for the mammary glands of the udder to be restored to achieve maximal milk production after a new calf is born. It is also considered to be the best period in the lactation cycle of the

cow to treat subclinical cases of mastitis<sup>12</sup> (AHDB Dairy, 2017b; Biggs, 2017). Previous guidelines recommended the ‘blanket’ treatment of cows with ABs in the dry period, and it has since become the biggest hotspot of prophylactic AB-use. The aim of dry cow therapy was to reduce the prevalence of mastitis by treating existing intra-mammary infections (IMIs) and to protect new IMIs emerging (Scherpenzeel et al., 2016). Practically, this meant every cow was prophylactically treated with a long lasting AB (e.g. Cepravin, Urbor Red, Orbenin Extra) in each teat of its udder (Biggs, 2017). However, research has shown that cows with a low somatic cell count (SCC) at drying off who receive AB dry cow tubes are actually at increased risk of having *E. coli* type mastitis in the first 100 days of the next lactation (Cafre, n.d.). Pharmaceutical company Zoetis introduced Orbeseal in 2002, a non-AB internal teat sealant that could be used in healthy cows instead of an AB teat sealant to reduce the risk of new infections in healthy cows. Blanket dry cow therapy has been reappraised over the years in which Selective Dry Cow Therapy became the new golden standard (Biggs, 2017; Scherpenzeel et al., 2016). Instead of blanket use of ABs in all cows who are drying off, Selective Dry Cow Therapy (SDCT) was introduced as method that selects only those cows with evidence of an udder infection to be eligible for AB treatment. All cows receive an internal teat sealant (Orbeseal) irrespective of whether they receive AB dry cow treatment or not (Biggs, 2017; Scherpenzeel et al., 2016). Selection criteria for SDCT are herd specific (Cafre, n.d.) so information must be available. This includes individual SCC data over past few months, clinical mastitis history in current lactation, bulk tank SCC trends and ideally, bacteriology available from milk samples taken from clinical/sub-clinical mastitis cases. Hygiene is critical during drying off with teat sealants to avoid infection. Screening for infected quarters is equally important to avoid increased risk of infection (Cafre, n.d.)

In the responsible AB-use of ABs industry discussion, UK milk processors see SDCT as the most important strategy to reduce AB usage of their farmers and with it, the risk of milk residue failures. Milk processors started to implement SDCT strategies from 2015 onwards.

*“The drive to reduce overall antibiotic use has taken place over the last twelve to eighteen months, and that is pretty much focused on selective dry cow therapy. So our view is that probably over half of all antibiotics that are used are drying off. So if you can influence the*

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<sup>12</sup> Mastitis is the inflammation of the cow’s mammary gland and udder tissue and is one of the most frequent diseases in dairy cattle (AHDB Dairy, n.d.-c). Because of its endemic presence across national dairy herds, it has important economic implications as there are large costs associated with reduced milk production and milk quality, treatments, premature culling (Laven, 2018) and animal welfare implications (Martin, Barkema, Brito, Narayana, & Miglior, 2018). In the UK, mastitis treatment and control is one of the biggest costs to the dairy industry and there has been much debate over the years how to structure and co-ordinate mastitis problems across UK farms (AHDB Dairy, n.d.-c).

*strategy that farmers use in drying off, that is the way you can have the biggest impact on antibiotic usage.” (Milk processor 1)*

*“There has been a real push for selected dry cow therapy from the local dairies” (Veterinary surgeon 5)*

Milk processors also differ in their SDCT approach. While milk processor Arla request their farmers perform SDCT in at least 10% of their herd (Arla, 2017), other milk processors chose to ‘work with farmers’ to achieve SDCT (Interview milk processor 1). Milk processors have organised training events on SDCT practices and to some extent on husbandry management to facilitate the exchange of information between farmers and vets with a view to improving on-farm practices. It is believed this will mobilise vet and farmer communities.

*“We introduced selective dry cow therapy over here. We introduced it and thought about it [...]. And basically, the conclusion was, it is not for us to say how you do it. It is for the vets. We must not interfere with that. We should facilitate and try and create a momentum so that, a farmer tries it, will influence the next farmer, and the next farmer and the next farmer. But we can’t influence all of them. So, how it works, vet practices would influence another vet practice by association. There is still some resistance out there, but the changes are quite incredible. We haven’t got enough facts and figures to know what the usages are. How do you measure it? But certainly, anecdotally, in the feedback we are getting, you know it is happening.” (Milk processor 2)*

This milk processor relies on anecdotes to evaluate whether their role as policy facilitator has impact. Interestingly, milk processors therefore do not appear to have focussed on getting the metrics to demonstrate whether their SDCT ‘snowball’ training events have succeeded, but instead, rely on anecdotes of farmers and vets. The ‘success’ of policy interventions is ‘covered’ in AB sales/usage metrics in the UK-VARSS report. There is however a gap in knowledge how these interventions are done in practice by farmers and how they reduce farmers need to use ABs.

### 6.5.3 Milk residue governance: training farmers

Across milk supply chain stakeholders, farmers are considered as the ‘biggest risk’ to milk residues (Interview, industry livestock organization 3). In particular farmer’s off-label use of ABs causes problems as this changes AB milk withdrawal periods. Going ‘off label’ with AB-use means using medicines outside the terms of the licence. A classic example is the use of



Tetra Delta tubes (Beta-lactam) during mastitis treatment. This treatment has a milk withdrawal of five days when dosed at treatment day one and complemented in some cases 24 hours later with another dose. However, most farmers will go off-label by prolonging the Tetra Deltra Tube treatment with five consecutive days or topping up the Tetra Deltra Tube treatment on day one with an AB injection (Interview Veterinary surgeon 18). This prolongs the original withdrawal time of the Tetra Deltra tube with a minimum of seven days according to cascade use of ABs. One vet suggested that some farmers are not aware of these mechanisms or misuse, which increases the risks of raw milk residues entering the milk supply chain (Interview Veterinary surgeon 21). Farmers, therefore, are considered by milk processors as a risk to the production of milk residues, as they do not always know how to use ABs responsibly.

*“They don’t necessarily know what going off-label is, because they might have never actually read what the on- label treatment is. And they also don’t always realise that by going off-label, they are increasing the risk of residues because of the topping-up effect.”* (Veterinary surgeon 21)

To reduce the risk of milk failures, Dairy UK, in cooperation with the British Cattle Veterinary Association, designed a training program for farmers and vets (RUMA, 2017, p. 17). This training program is called MilkSure and has been launched recently. The aspiration is to put every farmer who has an AB test failure through that training course, ideally with their own vets. The programme involves guidance on how to use AB test kits on farms, training on how to perform SDCT and how to use teat sealants, with the whole aim to minimize medicine residues (Dairy UK, n.d.).

*“The UK Dairy antibiotic working group is charged with, basically, finding a strategy to reduce residue failures. One of the key things out there was the professional training for farmers, which is how MilkSure came about.”* (Milk processor 2)

‘MilkSure’ as a training opportunity has become part of the Red Tractor Assurance Dairy Scheme (2017, p. 20). It is *recommended* that at least one member of staff undertakes a medicine training course (including, but not limited to, MilkSure) and holds a certificate of competence (Red Tractor Assurance, 2018). It is believed these training programmes will ‘optimise’ farmer’s AB-use.

Some milk processors have introduced milk price penalties for milk residue failures to ‘manage’ farmers’ AB behaviour.

*“If we collect some milk that is contaminated with antibiotics, we don’t only not pay anything for that milk, we actually charge the farmer 10p per litre for that milk.” At the end of the day, it is the stick and carrot isn’t it? If you hit them financially, they will change their behaviour.”* (Milk processor 1)

Milk processors push their farmers to use ‘AB test kits’ on farms, to test the milk of individual cows in case ABs have been used. On farm rapid AB screening tests are commercially available. This allows farmers to test if raw milk that comes from cows that underwent AB treatment is ‘safe’ from AB residues and/or to test milk from the farm bulk tank. The self-governance of milk residues at individual cow level by farmers is an important part of milk purchasers/processors agendas.

*“So we work very hard with our farmers to ensure that, if they use antibiotics, they actually make sure they test their own milk before that milk goes into the milk factory for collection by ourselves. And there are some very heavy penalties for farmers who have an antibiotic failure on collected milk. So, it puts the emphasis on them to do the test before we collect it...I think probably over 80% of farmers will test their milk, either with a quick or full Delvotest every day now.”* (Milk processor 1)

#### 6.5.4 The Dairy Red Tractor Scheme

Red Tractor farm assurance standards are positioned as a trustworthy mechanism to drive change and standardise farmer practices.

*“Red Tractor Farm Assurance Standards are a very powerful instrument for achieving change on farms because they have achieved 95% coverage in the dairy industry which is much higher as in other sectors, so changes in dairy are red tractor standards, ensuring the entire industry moves together simultaneously. But to do that, there have to be consensus among the industry to what those standards should be, but red tractor recognises that the whole issue of AMR and antibiotics is becoming more and more important, and instead of waiting for the normal 3 year revision cycle, they are prepared to amend and change their standards, in order to address this issue in a much shorter interval”.* (Respondent Livestock industry organisation 4)

Milk processors request their contracted farmers be Red Tractor farm assured, which covers AB and herd health quality assurance standards. During my fieldwork in 2017, the Dairy Red Tractor AB quality standards were under revision. Since March 2018, all Red Tractor dairy farmers are now required to undertake an annual review of their medicine records (written or digital) with their vets. The farmer’s total AB usage is evaluated between the farmer and the vets, so the vet can come up with responsible AB-use recommendations without compromising

animal welfare. AB failures, overall use of dry cow therapy and AB protocols also need to be discussed. These quality standards are believed to foster responsible AB-use communication between the farmer and the vet. In addition, HP-CIA's as defined by the European Medicine Agency (3<sup>th</sup> and 4<sup>th</sup> generation cephalosporins, fluoroquinolones and colistin) can only be used since June 2018 as a last resort after sensitivity or diagnostic testing.

Having introduced the milk processor policies and Dairy Red Tractor Farm Assurance Standards, I will next discuss the practices of these policies and the overflows they generate.

#### 6.5.6 The overflows of milk processor-led antibiotic policies:

##### **SDCT: problem of translation**

The vets in this study had a range of different dairy farmer clients with whom they had differing relationships. They reported that this affected their ability to communicate AB policies across farmers. Equally, knowledge transfer tools such as protocols, training, and videos were not always adopted by farmers as expected by industry policymakers.

*“One of my farmers is drying off during milking rather than separating the cows out and drying off after milking. You could talk to him about that until you are blue in the face and show him all sorts of videos of farmers drying off as a separate group and they will find all sort of ways to critique him [...] The nature of farmers as well is you are dealing with people that have been doing things for a long time but don't always think what they are doing is wrong. So trying to take people, farmers, who see that they have a problem in the first place, seeing where that problem might be coming from, seeing that they could do about that problem and then actually doing something about it is a...you have farmers on many different stages in that process.” (Veterinary surgeon 5)*

*“Sometimes people are just very, very busy. Like it is hard to change your protocol and policies [...] that is why we have always done it cause dad did it. But it is hard to change that because it takes time and effort and thought and if you are already working at full capacity...it is really difficult to change that. And some of them just don't have the money. I think for some people, you know, there is farmers where that is not an issue. They are actually very profitable. [...] I think there is also a massive percentage of farmers who genuinely don't necessarily want to engage with the information and don't always see it as their problem, because there are some farmers who basically want their vets to sell them drugs. It is hard to change that.” (Veterinary surgeon 2)*

Farmers identified the differences between artificial workshop settings and farm realities. While artificial 'classroom' settings fostered communication and knowledge exchange

between farmers it did not reflect the reality of working on a farm.

*“You need to get mud on the boots. They need to be out. They need to see it.” (Farmer 1)*

At the same time, during my fieldwork farmers talked about their solitude, how sometimes not seeing other people for days, makes them susceptible to the continued use of habits in their day to day work. With nobody to question these farmer’s work routines, the risk increases of irresponsible AB usage practices slipping in their practices. One of the farmers highlighted the need for continued on-farm support.

*“Arla and some of the other dairy processors have offered workshops to their farmers about the physical act of dry cow tubing. But what they haven’t done is...support them in the whole process. You know, they have focused on ‘that is the issue’. But that is just one point in the process, there is a lead up and a follow on [...] oh they are talking about huge failures? You know, some people are saying oh you need to use the medicated wipes. You might as well throw them in the bin as soon as they arrive. (Farmer 1)*

Another problem of translation concerns the lack of National Milk Recording by farmers. Farmers can pay UK’s National Milk Recording (NMR) organisation to supply them with milk recording services. This provides farmers with management information on an individual cow’s performance in terms of milk quality, yield and fertility. NMR are UK’s market leader in the provision and support of dairy software and produce records for 60% of UK’s milk (National Milk Recording, n.d.). NMR provides farmers with insights upon the Somatic Cell Count (SCC) of their individual cows which is crucial in SDCT adoption. As previously discussed, the history of a cow’s SCC is one of the most important parameters to start SDCT or not. Farmers who are not milk recording lack opportunities to safely adopt SDCT without compromising welfare or losing cows.

*“In some ways it is quite difficult, so in this area, the herds are much smaller for the dairy herds. So maybe they have 70 herd, you know. And they don’t do milk recording, to therefore it is really hard to do targeted antibiotic therapy. Because we don’t have individual somatic cell counts for those cows, which actually in itself can be a bit of a welfare issue because if you are not doing it sensibly, it is how you are picking your guys. And there is a cost implication for those farmers. They are already the small guys. They are already the guys who, you know, it is really difficult.” (Veterinary surgeon 2)*

NMR is not obligated across the dairy supply chain, which puts farmers in charge of this economic decision.

*“We are thinking about doing, like with Orbeseal, we have always done dry cow just as blanket coverage across the herd really. We have quite a low cell count really, so whether we need to really...we don’t’ do NMR test the cows or record, whether we should be doing that really [...] perhaps we should look into that sort of thing .”* (Farmer 2)

As NMR is a cost added to the daily bill of a farmer (rather than seeing it as a long term investment), farmers may choose to stop recording in less prosperous times to save money.

*“When the milk price drops, many farmers tend to drop out of NMR to save money”* (Veterinary surgeon 18)

SDCT adoption by farmers is not a matter of simple knowledge transfer; actors in the farmers’ network such as NMR, milk prices and the milk contracts (with whom and its conditions) all shape farmer decision-making. In this context farmers produce their own ways of *doing* SDCT.

*“They ask you online if you do SDCT, and I say I do because I do some, but I don’t do SDCT in general. And some farmers fill in they do SDCT but they don’t.”* (Fieldwork notes, retailer meeting Ardingly)

*“Issues you see in SDCT is that farmers now use 1 antibiotic tube in 2 teats. This lowers antibiotic use but actually, increases risks of infection and in the end, antibiotic usage. So SDCT is actually failing to be executed, but they are trying to mask it.* (Veterinary surgeon 13)

### **The perverse incentives of milk residue policies**

Farmers are driven by different pressures in their agricultural network. Since milk processors began to tighten milk residue control in raw milk, farmers are increasingly testing milk that originates from medicated animals to avoid the uncertainty of milk residues entering their milk bulk tank. Farmers are using the AB self-test as an opportunity to evaluate how they can use ABs without the risk of testing milk residue positive. Instead of evoking a sensible risk behaviour towards AB-use, it develops into a culture of what farmers can get away with.

*“Farmers just don’t keep the milk out of animals that had a non-antibiotic treatment, and they also know there are certain antibiotics they can get away with. So it is a trial and error. A lot of farmers have the Delvo tests themselves on the farm and they know what they can inject the cow with betamox, and it won’t fail the Delvo test. So they let the milk in the tanker, which is*

*quite a bad common practice that has slipped into the industry...what a lot of farmers are doing is that 'well we use the Delvo test in order to play a game of fruit machine', find the earliest data when I can put the milk back in the tank, therefore I am not having to throw away milk unnecessarily, because it is costly, so I will pay for the Delvo test now.'* (Veterinary surgeon 21)

As highlighted above the penalising systems and control systems of milk processors create a reactive response of farmers instead of structural changes in their AB practice

*"The payment system where we test farmers and penalise if they fail, it is a bit like speed cameras. They work because they suppress but they don't improve if you see what I mean. They just prevent it from getting worse. The only way you can improve if you have arguably less cars on the road. If you have less cars than the failure rates of speed cameras will go down. No matter what you are going to do, you will keep things maintained but not make it go any worse, with the payment and penalties, and I hear it when I am talking to the farmers, it is all about the penalties."* (Milk processor 2)

The penalty systems introduced by milk processors and the use of on farm milk residue tests have resulted in farmers disposing of more 'waste' milk into the environment than before. Before the introduction of AB policies, AB 'waste' milk was fed to calves. However, under Red Tractor guidelines 'waste' milk should not be fed to calves anymore to avoid risk of 'AB residues' in another part of the food supply chain (Red Tractor Assurance, 2017). As a result, some respondents suggested that farmers now dispose the waste milk on their lands or in slurries, which creates a new 'uncontrollable' pathway of milk residues. Consequently, by creating a system that 'protects' the food supply chain from milk residues, a potential 'environmental' cost is 'co-produced' at the same time.

*"We see massive changes of attitudes with regards to ABs and farmer. The truth is, they are probably disposing more milk than they have ever before. If they have an accident, it is much more beneficial for them to just get rid of the milk, as opposed to be charged 10p if they are found to be in breach."*(Milk processor 1)

### **Red Tractor as 'paper reality'**

The Red Tractor scheme represents minimal standards of animal welfare, food safety, traceability and environmental protection (Red Tractor Assurance, 2017). The next quotes demonstrates however both limitations of Red Tractor Farm Assurance and its advantages

*“We recognize that one of the weaknesses of red tractor standards is that they are processed based standards, they essentially check whether the farmer has a correct procedure, equipment and processes in place to deliver on requirements. Now, what they don’t always emphasize is outcomes, whether or not they are actually delivering on those standards, that’s why there was some evolution by the Red Tractor towards outcome based data, and, so there is a perpetual discussion going on in the industry how you can make the implementation of the standards much more effective, that it actually achieves the outcomes you want to see. But most people regard the standards of Red Tractor as quite a good scheme, and certainly the government is quite happy with it. It is seen by the industry, retailers and customers as providing the necessary baseline from which they can differentiate standards if they want to. And overall, it’s also I think, delivered confidence to the consumer, the industry is operating at relevant standards or appropriate standards of animal health and welfare, because there is very little pressure to change.” (Respondent Livestock organisation 4)*

The industry recognises that there is uncertainty in whether Red Tractor Standards actually deliver on what they promise on paper. Nevertheless, the Red Tractor Scheme has established itself in the UK as biggest farm and food standards scheme, recognised by the UK government and trusted by consumers. By incorporating responsible AB-use standards in the Dairy Red Tractor Farm Assurance Scheme in 2018 (Red Tractor Assurance, 2018), the established credibility of the scheme makes the UK government and consumers believe that ABs in dairy farms are used in a responsible manner. Various respondents (farmers, vets, consultants, milk processors) with whom I spoke during my fieldwork were keen to emphasise some of the limitations of the Red Tractor as farm assurance scheme. Any change to the Red Tractor standards has to be approved by the National Farmers Union and therefore farmers. Industry respondents argued that the standards are designed to impact as little as possible on the farmer production costs. The Red Tractor scheme was therefore seen to be largely responsive to pressures than proactively tackling issues - which might help explain the time it took to get HP-CIA standards implemented in their quality assurance scheme. Respondents also suggested that the Red Tractor scheme allows farmers to approach their Red Tractor obligations as a ‘tick box’ exercise rather than as a tool that supports innovation.

*“When you do your Red Tractor assessment they don’t measure any barrier space or cubicle space. They don’t count your cows or your cubicles. They have all recommendations of what should be but nothing is actually controlled. It is a paperwork exercise, tick a box, as long as you meet the major compliances. It is not good. Red Tractor is not good. It is the basic standard. Which a lot of farmers would say ‘well yeah, but don’t burn yourself with cost’. That is a fair comment, because cost drives down profit.” (Farmer 2)*

*“That is one of the problems with farm assurance, you know, a lot is a tick box exercise [...]. And if they do it by tick boxing they are probably not doing it for the right reasons. And we*



*have people like that, of course we have that. It's hopefully at the time it will be less and less of them.” (Milk processor 2)*

*“We have a system for recording medicines that is legally mandated in the UK by Red Tractor, which is the medicines book. That, at the moment, is a paper based record system which is completely and utterly useless. If anyone can give an example of when a product recall was based around going into a farmers 'medicine book and checking batch numbers, I will be very surprised indeed.” (Veterinary surgeon 21)*

The lack of proper assessment of Red Tractor standards moreover seduces farmers to falsify records.

*“What really struck me was, this farm was filthy. The house was filthy, the bathrooms, everything was absolutely filthy, he was filthy. This record book was immaculate, absolutely immaculate, not a spillage, nothing on it. Same pen and that was really good. I said about this when I went back in. So he showed me the calving issues, it was on the computer and I looked at it and he had written it out in the wrong month. So he had obviously written it before we came, done all the right cows and everything else, all the treatments but done all the records in the wrong month. So he transcribed it wrong. So that was the end of that. It was falsified records.” (Milk processor 2)*

The Red Tractor scheme represents as such a ‘paper reality’: there is a difference in what farmers say on paper and what they *do* in practice.

### **Competing interests**

Milk processors operate in competing markets and have economic relationships with farmers and retailers. As farmers are able to choose where and how they contract with milk processors, there is now competition between milk processors to recruit farmers. To maintain their dairy supply to their contracted retailers, milk processors will want to keep farmers contracted. Consequently, milk processors will in most cases work with farmers in order to co-construct policies and remain transparent to their farmers.

*“I just can't see who is going to push it forwards. So the milk buyers are nervous about imposing it on their farmers, because none of them wants to be seen to be the bad guy. Again, farmers have a lot of power.” (Veterinary surgeon 21)*



*“We would like see this dealt with as an industry issue, but on the other hand, milk processors are under pressure from their retailer customers to see if there is any commercial advantage to have from it, so they are trying to find a way to reconcile that commercial pressure.”* (Respondent Livestock industry organisation 2)

Political pressure of responsible AB-use has forced milk processors to engage with AB strategies and improve their milk residue management. Milk processors use SDCT as the main strategy to achieve responsible AB-use. HP-CIA policies and recording strategies are transferred to Red Tractor farm assurance. The reason that their main focus is on SDCT, is that it offers a strategy to both cut AB-use and milk residues. Milk processors are concerned with what matters most to them: milk residues.

*“At the end of the day, we are a milk processing company that supplies liquid milk to retailers. Our main focus has to be that there is absolutely no antibiotics in the milk that we process, and that is our main focus. So, while we are working with our farmers to reduce their overall use of antibiotics, our main primary focus is to ensure that we process antibiotic free milk and supply antibiotic free milk to our customers.”* (Milk processor 1)

## 6.6 Retailers economisation of dairy quality standards

As previously discussed (Chapter 5), retailers in the UK are increasingly dictating the quality assurance schemes under which food supply chains produce. At the same time, a rise in consumer agency has pushed retailers to incorporate consumer demands into their food market strategies. Buller & Roe (2014) highlight the retailer-consumer relationship by discussing the consumer-led commodification of animal welfare in free-range layer chickens. Using Çalışkan & Callon (2009) concept of ‘economisation’ and ‘marketisation’, they show how consumer values are translated in welfare-friendly free-range layer eggs and new market opportunities. To meet market demands, food supply chains have been pushed to innovate their technologies (for example dimmer lights) and practices (labelling of products). ‘Doing animal welfare’ from ‘farm to fork’ by food chain actors is represented by a range ‘procedures, technologies and performances’ that ‘add’ welfare standards to the chicken body (Buller and Roe, p.142). In this way, the food chains’ interpretation of consumer concerns shapes new markets and increases retailer’s power over the bodies of animals (Buller & Roe, 2014).

Equally, consumers expect animal welfare, milk safety and milk quality husbandry standards to be translated into the production process of dairy products. In return for a milk price, retailers set out standards in their milk contracts that farmers have to implement in their daily

practices.

*“They have to mobility score their cows in terms of mastitis incidents, metabolic disease etc. etc. And so, then, part of that platform involves benchmarking. So you are able to say to farmers ‘look, it is not normal to have 150 cases of mastitis, you are right out on a limb here’. And try and use that as a way of facilitating improvements”.* (Veterinary surgeon 20)

Importantly, with consumer profiles driving dairy quality assurance standards, customer profiles will determine a retailer’s product differentiation strategy from other retailers. Whereas some retailers in the UK will have customer profiles with high expectations of food/dairy quality, other retailers have customer profiles who expect affordably priced products.

*“It is more of a brand issue, so consumers expect higher standards of some retailers more than others.”* (Retailer 1)

Most of the major UK retailers will have customer profiles who expect food/milk products of a certain quality.

*“From a retail public facing point of view is that, the public is only interested whether you use antibiotics or you don’t. I think in dairy that is a challenge, but what we are doing now is restricting it and having the evidence that we actually have restricted it you know, so you always have it in your toolbox.”* (Retailer 1)

From 2010 onwards, media and public concerns have made responsible AB-use of concern to retailers. In response, some of the major retailers started to implement AB policies from 2010 onwards, with policies mainly focusing on AB usage recording (Interview Retailer 2, Veterinary surgeon 2). The publication of the O’Neill report in 2015 and the media concerns that came with it renewed retailer’s attention to the issue. Retailers feared media messages that threatens consumer trust in food supply chains.

*“I could hear from a retailer perspective what was important. And for them it was important to demonstrate that they are doing something, because everyone is sort of dreading the Daily Mail story of antibiotic found in milk, or breaking the story of 99% of calves receive antibiotics’ orally for the first week of their life, something like that.”* (Veterinary surgeon 21)

From 2016 onwards, to avoid negative publicity on the issue, most UK retailers have implemented antimicrobial policies across their food supply chain. The dairy industry is considered as a particular risk to retailers, as the industry lacks oversight in how dairy farmers operate.

*Retailers feel they have a far more vulnerable relationship with their dairy supply chain than they do with their beef and chicken supply chain for example [...]. There is a massive range of dairy farmers. You've got some really good operators, and you've got some shit operators. So that makes them feel vulnerable. So retailers want to be able to show they are doing something, working with their farmer suppliers to reduce the routine use of antibiotics. (Veterinary surgeon 21)*

Retailers have four focus areas in the dairy industry through which they operate: AB usage monitoring; HP-CIA reduction strategies; Selective Dry Cow Therapy; and Herd Health. In what follows, the four focus areas in dairy will be discussed. It will be argued how responsible AB-use policies driven by market demands, result in intended and unintended practices of the policies.

### 6.6.1 Antibiotic monitoring

What matters to every retailer in the AMR discussion is that they are able to provide transparency on AB-use in their milk supply chain. Metrics on AB reduction numbers are of particular interest to retailers, as this visible evidence provides accountability towards consumers that responsible AB-use is being done by their farmers. With the AMR food debate gaining publicity over the last decade, some of the major retailers had started to monitor AB usage data from their dedicated farmers' milk pool.

*"A lot of the retailers started monitoring the amount of antibiotics being used about seven years ago, and then it has really been a slow build from there." (Milk processor 1)*

Through online data systems operated by the retailers, farmers are asked to fill in their AB usage. Retailers use their own technologies and experts to analyse the AB usage data. Some of the major retailers use the AB usage data to benchmark one farm against another. In case a farmers' AB usage is higher than the average they are pushed to undertake initiatives that lead to reduction in use (Interview Retailer 1). In addition, retailers use the AB surveillance data to stimulate farmers self-governance of responsible AB-use.

### 6.6.2 HP-CIA reduction strategies

Retailers have responded to the concerns of HP-CIA use in dairy by implementing HP-CIA policies that restrict their use. During my ethnography of retailer-farmer meetings in 2017, I observed the introduction of new HP-CIA policies. As previous HP-CIA restriction initiatives had failed, ‘interactive’ sessions across the country were organised in order to transfer the new policy to farmers and vets. The interactive sessions involved a presentation by the retailers in which the evidence-based HP-CIA policy was introduced. Farmers and vets were able to pose questions afterwards. Importantly, farmers received points for attending the meetings. It was believed that these interactive meetings fostered farmers’ adoption of the HP-CIA policy.

*“Since 2011 was the first time that famers had to start to report their use of HP-CIA and had a plan to reduce that. What we have done in January is that we focused on the mind of farmers, we don’t believe that we have moved far enough yet and therefore we should encourage farmers to make further steps to improve [...] even though the farmers have been aware of it the last 6 years, there hasn’t been a massive swing away from HP-CIAs, that we could show in our results. So the feeling was we needed to communicate back and re-focus our efforts in trying to encourage farmers before there was legislation”. (Retailer 2)*

This was one of the first retailers to introduce culture and sensitivity (C&S) testing as diagnostic test to legitimate HP-CIA use. Through a sample of the cow’s body fluid (urine, blood, milk) the sample can be cultured to test what ABs the infection is sensitive to. HP-CIA’s can only be used as a last resort in those cases where resistance is observed against every other AB. At that time, farmers and vets were allowed time to transition to these new mechanisms and to understand the resistance profiles on the farms. Farmers and vets were still allowed to use HP-CIAs, but accompanied *with* a C&S test to see whether it was necessary to use a HP-CIA. The use of C&S tests prior to HP-CIA use gradually became the norm across retailers, and since June 2018 was also incorporated in the Dairy Red Tractor standards (Red Tractor Assurance, 2018).

*“CIA’s in dairy cows is part of farmers medicine toolbox but there is a pretty strict protocol you must follow, to ensure it is their last resort. You look at the history of the farm, you do your C&S, you’ve tried all the other antibiotics before you refer to a CIA. And that needs to be sort of coupled with reporting back on CIAs just so that we can clearly have the transparency about demonstrating that we’ve restricted them, here are our results, guess what, we don’t use them anyway”. (Retailer 1)*

Other initiatives included the physical separation of HP-CIA's from non HP-CIAs through a separate medicine box in order to put barriers in place to prevent farmers easily accessing HP-CIAs.

### 6.6.3 SDCT transparency

On top of milk processor initiatives, retailers also encouraged their farmers to start implementing SDCT. As HP-CIAs were the first drug of choice in udder related issues, this supported the reduction in HP-CIA use by farmers. In cooperation with milk processors, retailers organised SDCT workshops around the country to introduce SDCT. Although RUMA guidelines forbids the prophylactic use of ABs, the retailer in the next quote frames SDCT as 'targeted prophylactic' use.

*"I mean in dairy, the big issue there is DCT. We are sort of moving that into what I guess you could call targeted prophylactic use. We have only just started this now, but basically farmers have targets of cows they aren't giving DCT, so rather just being a routine thing you do, right, there's at least some sort of a thought process going into, do you need to do it or, don't we do it. So that's the route for 6 month."* (Retailer 1)

The SDCT trials are accepted across industry policymakers as a transition period to move away from prophylactic dry cow therapy. With farmers being inexperienced with SDCT, this gives farmers the time to get used to SDCT procedures.

*"I make sure that it is benefit to farmers to record the information around health and welfare and recording the use of ABs, and other medicines, and recognize health as a responsibility, but also as a benefit to the farm, so they can benchmark themselves, and understand where there are areas to improve."* (Retailer 2)

### 6.6.4 Herd Health quality score

Retailers have their own teams of experts who will translate consumer expectations into milk contract expectations. As previously discussed, retailers define herd health through the performance of farm assurance standards set out in milk contracts. These farmer assurance standards exceed the Dairy Red Tractor Scheme and are used by retailers to 'design' exclusive milk pools and actively compete against each other in competitive milk markets. Retailers increasingly push farmers to record herd health and welfare activities on their farms. The herd health performativity of farms is used to identify areas of improvement. Retailers can use this

information to promote good husbandry practices in their food supply chains to consumers. Herd health performativity has become increasingly linked with AB performance on farms by retailers.

*“We develop our dairy health index score based on the AB-use in calves and cows, and a number of other parameters as well, but primarily, that information is stored within our centicate. They number crunch the information and that gives us a score of each farm. We can then benchmark each farm one against another, and use that information to develop strategies for those farmers who we believe and we can identify using far more ABs than the average or good dairy farms.” (Retailer 2)*

By improving the body and environment of the cow, it is believed farmers will reduce their use of ABs. This enables new commercial platforms to emerge for those retailers who are chasing differentiation in milk 'quality with their 'dedicated' milk pool.

*“I think it's also important to understand that, although this is a pre-competitive issue, there is competition internally between retailers to make sure that they stay ahead of their competitors in terms of animal health, welfare. This might not be something that they communicate with the public because no one walks out of that looking good. But they will always want to point at differentiation, to talk to their shareholders about why they are different. So to think that they will all comply with one single standard and say, you know, it's a bit like animal welfare. So, all dairy suppliers in the UK are Red Tractor standard. But obviously, each individual retailer has a welfare or health standard that exceeds Red Tractor requirements. They want to press on and push forwards and they want to point at differentiation. So, you're never going to come to them and say, “Right, here's Red Tractor Plus, can you all sign up here and this will be for, if you like, a next tier up.” They won't all do that because they want their own schemes, they want their own control, they want their points of differentiation. And I think, to a certain extent, that will be true, er, you know, of antimicrobial usage policy.” (Veterinary surgeon 20)*

Other retailers with customer price sensitive profiles may not have a 'dedicated' milk pool. This means they are not directly involved with the production standards under which farmers produce. In this case it is the milk processors who set the quality assurance of milk production. However, recent media attention upon the lack of transparency in responsible AB-use policies and levels of AB usage across retailers has pushed retailers to come up with data surveillance strategies. Where retailers do not have a contracted pool of farmers, a milk processor respondent suggested, that retailers 'work with' farmers in a softer way to encourage responsible AB-use and recording.

*“If you take Asda, they don’t have a contracted pool of farmers, but they do development and workshops, and McDonalds are similar actually. So they don’t set a standard like Tesco would or Sainsbury would have. It is more working with them on certain things, like AB recording.”(Milk processor 2)*

As such, the retailers will have evidence of AB policies in place, but farmers are responsible for implementing them in their daily practices without supportive and/or control systems in place to know whether this is actually happening.

### 6.6.5 Overflows of retailer-led antibiotic policies

#### **Antibiotic usage data: paper realities**

During my fieldwork and interviews, it became clear that most industry members are aware that farmers use ABs ‘off the record’. Farmers themselves revealed that farmers as a group have access to prescription drugs through their secret stocks, black markets, neighbours and double milk contracts.

*“We arrive at one of the top farmers in the area who is on a retailer milk contract. I get the chance to speak with the farmer and to ask him some questions. The farmer argues he is happy with his milk contract and he works hard to reduce antibiotics as much as possible. He is however not happy with how other farmers are dealing with the antibiotic policies of the retailer. He says that farmers are not filling in the files correctly. They complete online retailer quality assurance forms as the best performers but in the meantime, they use different billing systems for their antibiotic registration or use their secret stocks. The farmer himself registers everything correctly, but he says how the practices of these other farmers make him look bad. He becomes rather agitated and says he has had enough of those practices and will start to name and shame those farmers”. (Fieldnotes Veterinary practice 3)*

The reliance of retailers on statistics creates ignorance to practices outside the reality of data. When I asked one of the retailers about the differences between what farmers reported doing and what they actually did, he framed this divergence as the ‘anecdotal evidence’ of jealous farmers, which was contradicted by his auditors.

*“I think anecdotally, farmers like to criticise other farmers for their accuracy, because it makes, I think to some degree, makes them feel better with regards to them maybe having a higher level than they would like to think of usage. So I think there is some anecdotal evidence of that, certainly my auditors who are out there and not reporting back to me substantial difference between antibiotic use reported and antibiotic actual use recorded, so reported and recorded, ehm, I am not getting back feedback that there is a significant differential between the two.”*



(Retailer 2).

The retailer in the above quote trusts his auditors to verify the validity of farmer anecdotes. Auditors and their operating procedures are trusted by this retailer to deliver an accurate picture of what happens on the farm. Although I have not been able to observe the operating procedures of auditors, fieldnotes suggests that farmers say and write down different practices to what they actually *do*. Auditors come announced to farms, which gives farmers time to prepare for their visit. They discuss with farmers the quality assurance standards as defined in the milk contract, but it remains difficult to police what happens with ABs during daily farm practices. At the same time, retailers all have their own data collection methods and expert teams who analyse the data. This makes the interpretation of how evidence reflects practice rather obscure.

*“Retailer x do their workshops, have their aspirations and their rules, but who collects their data and who is actually analysing this data and seeing whether or not it is accurate?”*(Veterinary surgeon 21)

### **Antibiotic policies as ‘tick boxing’ event**

I encountered different opinions among farmers about how retailers operate. Many farmers were happy to be on retailer aligned milk contracts, as this offered them security and support. At the same time, some farmers argued fiercely against retailer contracts, feeling constrained by their demands. Some of the farmers argued that they perceived the retailer quality assurance standards as a bureaucratic hurdle rather than a driver for change.

*“Their policies involve a lot of tick boxing but nobody actually reads the documents. We don’t feel understood, included in the program. I feel it is us against them. We have a lot of extra paperwork, we almost need a new secretary for all the paperwork.”* (Fieldnotes Retailer-farmer meeting Cannington)

Some farmers also expressed fear of losing their milk contract if they did not fulfil the expectations of the milk contract quality standards. One farmer reported that he had seen a farmer losing his milk contract when he raised his opinion during a retailer meeting. The fear of losing their milk contract potentially pushes farmers to find ways to get ABs without prescription and recording.



*“That is the mentality of farmers they are just trying to tick the box and keep Tesco’s happy”*  
(Farmer 2)

Although AB training and workshops were popular methods to inform policy, industry and supply chain actors about policies, farmers saw attendance as an obligation associated with their milk contract.

*“At the moment we seem to have series of workshops where we go to a nice hotel and we have a nice lunch and we have four speakers who talk to us about varying things. And we all fill a form in after, and we all go home and carry on and do what we were doing before. It was described to me the other day as: “Are you confident in what you’re doing?” This was another farmer. He said, “Are you confident in what you’re doing?” He laughed as he said it. I said, “Well, yes.” He said, “Well, do what I do.” I said, “What’s that?” He said, “Let it wash over you, tick the box, move on.”* (Farmer 2)

As they get points on their milk contracts for attendance, farmers will take the effort to show up at meetings. But instead of engaging with the knowledge-transfer programmes, some farmers see the retailer farmer meetings as a nuisance that disrupts their day. Although retailers then believe they have successfully transferred their policies through interactive sessions, farmers will still continue with their daily routine practices.

### **Culture & Sensitivity testing: object conflicts**

During my fieldwork observations, problems about C&S adoption were expressed by farmers. Firstly, farmers feared the economic costs of C&S testing. Secondly, farmers described C&S testing as time consuming because they had to wait for the results while their sick animals needed to be treated ‘hard and fast’. Farmers argued that C&S testing limited their ability to treat the sick cow quickly, which could mean they end up with a bad cow. Thirdly, farmers did not trust the C&S results due to anecdotes circulating in the veterinary and farmer communities that the tests were not accurate. Situations were discussed in which the C&S test showed sensitivity toward certain drugs, but in practice, the drugs were reported not to work. This made farmers and vets reluctant to work with the results of C&S. Although C&S testing was meant to be a barrier to CIA use, farmers argued that it could push their use so it was off the record.

### **SDCT: problem of translation**

During my fieldwork I observed many conflicts in SDCT communication and implementation by retailers. Some retailers trained local vets and obligated their farmers to do NMR. This facilitated the implementation of their quality assurance standards such as SDCT. However, other retailers announced SDCT as a new AB policy to their farmers without providing any understanding of the complexity of the procedure.

*“If farmers are hearing from the supermarkets in their contract that, “Oh right, we have to, we have to start doing selective dry cow therapy or, or at least have a look at it”, and they’re not adequate in their teat preparation and hygiene, well...we’ve had plenty of farmers that have lost cows as a result of that.”* (Veterinary surgeon 5)

Analysis of my fieldwork identifies vets and NMR as important actors in the agricultural network of farmers in support of the correct adoption of quality standards. Many farmers expressed uncertainties about how to implement or practice SDCT.

*“What is the cut off level of SDCT? Suppose I have 175,000 SCC but 600,000 in one quarter and the other 30,000, what do I do? Orbecyl? A longer dry-of period?”*(Fieldnotes retailer meeting Ardingly)

*“We have tried SDCT but I still feel very uncomfortable doing it.”* (Fieldnotes retailer meeting Devon)

*“ If vets had been involved beforehand then perhaps we’d’ve implemented some, some proper SDCT training.”* (Veterinary surgeon 5)

### **The public mis-representation of farmer friendly cost-production milk contracts**

Although the cost production milk price model offers farmers at least the cost-production milk price, farmers are worried that it could be used against them. According to farmers, the main goal for retailers of the cost-production model is to encourage farmers to invest in their farm so they become more efficient. This lowers farmers’ costs of milk production and consequently, allows retailers to lower the milk price they pay to their farmers. Although retailers advertise the cost-production model to consumers as a model that supports their farmers, farmers argue that retailers aim to reduce the milk price in the long term. Some farmers also argue that some of the retailers keep the milk prices down by their fixed milk

prices, disrupting the volatility of the milk prices.

### **Antibiotic policies as competitive issue**

The different circulating milk contracts (retailer aligned or milk processor non-aligned) translate into different approaches of how dairy supply chain members approach responsible AB-use. Most vets I encountered identified the power of retailers to drive change and improve activities related to responsible AB-use.

*“If you’re looking at trying to make change in, in whatever aspect of, you know, animal health welfare and antimicrobial usage, getting retailers who will, will make decisions, hopefully the right decisions, and get things instituted and policy in place and make change very, very quickly. Whereas, I think if left to other industry representatives, certainly if left to government, those changes won’t take place in any timely fashion.”* (Veterinary surgeon 20)

But as retailers are only responsible for a quarter of the UK’s farmer populations, they lack the power to drive the dairy industry as a whole.

*“Retailers, they set a marker, which pulls the greater pool a bit, but it only influences a relatively small percentage of the farmers directly. They have probably taken the 20% of the engaged ones anyway. So I mean, it is not very helpful”* (Milk processor 2)

In addition, spokespersons from across the sector and dairy organisations involved with AB policies argued that industry members use AB policies as commercial instruments.

*“Retailers are given a competitive market place and they are all seeking to find whether there is an opportunity for commercial advantage, so retailers and processors have their own policies and strategies on this. Some of them are more advanced. Those who have their own dedicated milk supply chains, they are in a position to put on their own obligations on their supplying farmers, and some of them have gone much further down the road than the entire industry. We do have concerns how this issue may be exploited commercially when we prefer to have it dealt with on a common uniformly industry basis [...] It is a dilemma the industry is facing on a number of issues. Especially when the industry’s reputation is being dealt with. It is a massive challenge if you can address it uniformly on an industry level or does it become a massive commercial advantage.”* (Livestock industry organisation 4)

*“Tesco tries to create a group of farmers that is ‘better’ than other farmers.”* (Fieldnotes Retailer farmer meeting Lanarkshire)

In addition, instead of driving innovation, the competition between dairy supply chain actors hampers communication on how to roll out certain AB policies.

*“We have the technology, we just don’t have industry agreement on how to actually roll that out. I realise I’m getting on my soap box again, but it’s something I think is incredibly important. And I think, until we’re at that position, we’re not going to really have a good grip on what is actually happening on farms.”* (Veterinary surgeon 20)

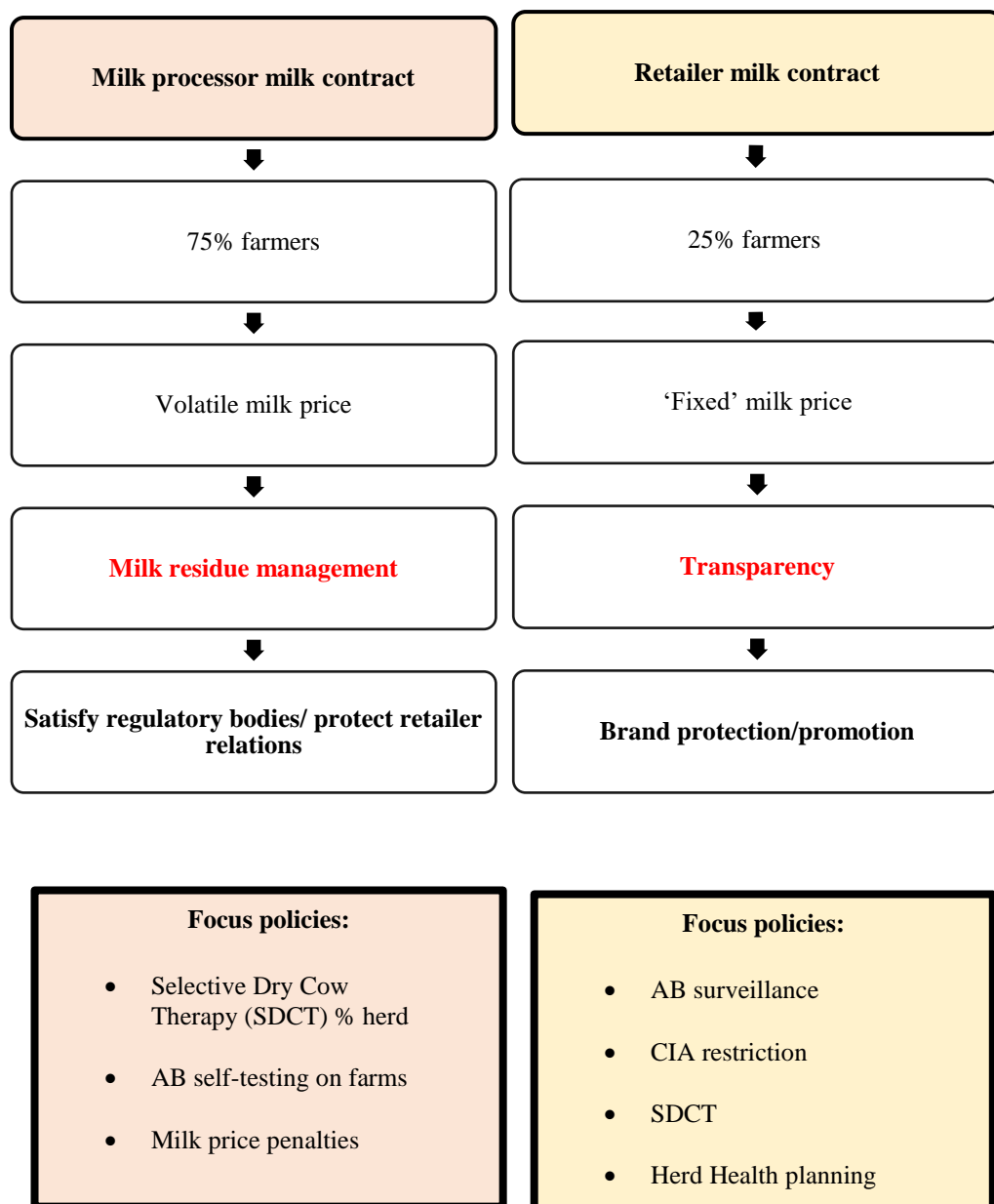
Not only market interests have turned responsible AB-use into a competitive issue. In November 2017 an article appeared in *The Guardian* newspaper comparing supermarkets on their publicly available policies on the use of ABs in its farm supply chain (Harvey, 2017): Waitrose scored best, followed by M&S, Sainsbury’s and Tesco, while third from bottom were Asda, then Aldi, and Lidl was the worst performer. In response to this publication, in November 2017, M&S was the first UK supermarket to publish information on their website about the *quantities of ABs* used on livestock by farmers that supply their meat, eggs and dairy products. Waitrose followed and became the second largest UK supermarket to make AB usage data available. Regardless of whether statistics are considered as trustworthy sources, the impact of the media on retailer antimicrobial policies was clear: what matters to retailers is to be able to provide evidence of reductions in AB-use.

## 6.7 Chapter discussion

This Chapter has demonstrated how responsible AB-use has resulted in different matters of concern to dairy supply chain members. Although the agricultural networks of milk processors and retailers overlap, they operate in different markets with different responsibilities (see Figure 6.2). Milk processors need to ensure their milk is ‘safe’ to keep the trust of official authorities (FSA) and the retailers they supply; while retailers need to ensure they fulfil expectations of their consumer profiles. Milk processors are under pressure from the FSA to improve their milk residue management, while retailers are pressured by the media and consumers to deliver transparency in their AB policy activities. AB milk residues have become their main priority, which drives the focus of milk processors’ AB policies. Farmers are considered the biggest risk for AB milk residues to enter into the food chain. Consequently, milk processors spend their resources on AB practices on farms that pose the biggest risk to AB milk residues: AB dry cow therapy. Some of the milk processors also incentivise the use of AB self-test kits by farmers or use milk price penalising systems to make AB-use less attractive. Most of the UK’s milk processors mainly rely on the Dairy Red Tractor Scheme to

improve animal health and welfare. Problematically, the findings of my fieldwork illustrate that the Dairy Red Tractor Scheme is a paper reality, rather than reflecting true practice. Most dairy supply chain actors require farmers to be Dairy Red Tractor farm assured, but farmers do not get financially rewarded in return. Consequently, farmers see the Red Tractor Scheme as a tick box exercise to get them milk contracts, rather than a mechanism they can use to innovate their farms. The quality of Red Tractor auditing is critiqued by farmers, making the scheme prone to falsification by farmers. As a result, farmers on non-aligned contracts with volatile milk prices are less driven to invest in their husbandry systems. Uncertainties of milk prices make farmers reluctant to invest in long term husbandry solutions. This results in difficulties to successfully implement SDCT, as this practice also involves good husbandry practices. In addition, some of the farmers use the policies to continue their AB practices. This results in responsive rather than preventative animal health and welfare actions. Finally, farmers might dispose of more milk in the environment rather than let milk residues enter into the food chains, although the environmental AMR burden of this practice is as yet, unknown. So although milk processor policies might result in less AB residues in the food chain, irresponsible AB practices on the dairy farm continue with unknown veterinary/public health and environmental effects.

Retailers in turn deliver dairy products that correspond with their consumer expectations. They are expected to deliver transparency in responsible AB-use activities. Providing AB usage surveillance data safeguards their market position. In addition, some retailers have started to align their herd health performance metrics with low AB usage numbers. By claiming that the healthy bodies of their dairy cows need less ABs, new market opportunities emerge. Market interests drive, in this case, the content of retailer AB policies. Different issues arise however when evaluating the practices of the AB policies. As retailer aligned milk contracts are popular, farmers will try everything to look good on paper. They will ensure they tick the boxes, but there is a lack of transparency in how farmers do the quality standards in practice. In other cases, farmers struggle with the complexity of the AB policies, such as SDCT and C&S tests. With a lack of veterinary engagement, this might result in counterproductive effects, increasing the need for ABs. Nevertheless, retailers strongly believe in the effectiveness of their methods of science - the numbers and metrics are trusted as accurate representatives of practice. The policies are therefore considered as sufficient, despite ignoring some of the structural issues related to AB-use on farms. Although the economisation of dairy AB standards by some of the retailers has the potential to improve the herd health status of dairy herds in the UK, this only accounts for a small part of the industry. The different focus of retailers and milk processors, together with Red Tractor Farm Assurance, segregates the dairy farmer landscape in their AB practices rather than unifying them (See Figure. 6.2).



**Fig. 6.2:** Dairy antibiotic use as 'matter of concern' to milk processors and retailers

The different content and practices AB policies across the dairy supply chain can result in new public health, food and environmental risks. Problematically, both milk processors and retailers are dependent upon farmers for them to implement their policies. Even though there is awareness across the dairy supply chain that farmers very often do different things to what they say they do, this is silenced when evaluating the impact of policies. The AB surveillance data of retailers and the latest annual UK-VARSS report of 2018 shows progress is being made and knowledge exchange programmes have been successful. Numbers contribute to the maintenance of irresponsible AB practices. This leaves structural problems in the agricultural

networks of farmers that contribute to AB to be unexplored. In the next Chapter, I will examine the agricultural networks of farmers and vets more in depth to better understand what makes farmers *do* different things than they claim.

## **Chapter 7**

### Dairy antibiotic decision-making in practice



## 7.1 Introduction

In the 'misuse and overuse' policy framework, farmers and vets are blamed for their 'inappropriate' AB practices. Evidence-based knowledge transfer programmes that stimulate the individual self-governance of responsible AB-use by farmers and vets are seen as one solution. This Chapter demonstrates how AB decision-making results from network activity rather than an individual act. Instead of exploring *why* ABs are used on farms, this Chapter will use Actor Network Theory (ANT) to study *how* AB decisions are made by farmers and vets in construction with other human and non-human actors in their agricultural networks (Latour, 2005). Actor-networks of farmers and vets will therefore be studied to understand which actors are most important during the AB decision-making processes on farms. This will provide insights in which actors can be used in policies to achieve responsible AB-use.

## 7.2 Disease informants

Dairy organisations and the RUMA task force plan (2017) have focussed on implementing disease protocols, workshops and training to improve farmer's management of disease with the expectation that this would reduce the need for ABs. However, these initiatives ignore other important actors in the network of the farmer that co-produce a farmer's approach to disease management. How farmers make sense of diseases within their actor-networks on farms 'co-produces' AB decision-making processes. The following discussion will discuss disease informants I encountered during my fieldwork and their role in a dairy farmer's AB decision-making process.

### 7.2.1 Lay protocols

When farmers sense that a cow is feeling 'off', it is often on the basis of a sense arising from vision, palpation, smell, or knowledge of that cow's usual behaviour. This may lead the farmer to undertake a more formal assessment of the cow - examination of the posture of the cow, appetite, milk production, vaginal discharge, ruminant activities, palpation of the temperature externalities such as ears, the type of manure produced, breathing rhythm, abnormalities in milk secretion and udder consistency. On this basis the farmer might arrive at a preliminary idea of where the problem is situated in the cow and what the problem might be. The farmer might also take the temperature of a cow to evaluate if AB therapy is required.

*“Basically just watery, yellow mastitis with a hard quarter and a sick cow with a high temperature was the farmer’s main use of Marbofloxine.” (Veterinary surgeon 5)*

An elevated temperature is associated in the mind of the farmer with infection *inside* the cow’s body, which to them then legitimates the AB treatment. This allows farmers to experiment with treatment before a vet is called.

**Farmer 2:** *“If they are feeling down, check the temperature, you know, depending on what you think about the cow, get the vet involved as well”*

**Interviewer:** *“At what point do you invite the vet?”*

**Farmer 2:** *“If we think it is something we can’t treat. If its past the point where we think ehm...what shall I say? Ehm...you get to know the cows, your own individual cows you get to know when they are not doing well.”*

**Interviewer:** *“So it is a lot of experience?”*

**Farmer 2:** *“Yes really, experience, you get to know what is going on really, and you get to know when you should call the vet out.”*

Through past experience farmers come to trust their own clinical judgment, and only call in vets when they encounter a situation with which they are unfamiliar or which they cannot resolve.

### 7.2.2 Phone advice

Previous research suggests that vets are a dairy farmers most important knowledge source to manage issues related to herd health (Jones et al., 2015). But, as previously discussed, vets are not routinely called in when a cow first presents with health problems. In many cases farmers will ring their vet to discuss a cow’s disease presentation with a view to being given an opinion over the phone and perhaps a treatment plan. Together a decision will be made as to whether the problem can be managed by the farmer or whether the vet needs to attend.

**Farmer 2:** *“We had one vet who used to say ‘Betamox is quite good for any feet problems, like an abscess’. But we had one the other day that wouldn’t clear up and the vet said ‘well perhaps you should try them on Tylan’, a stronger antibiotic, and it seemed to, touch wood, seemed to work tidy actually”.*

**Interviewer:** *“And this is phone advice?”*

**Farmer 2:** *“Yes phone advice”*

### 7.2.3 Farmer organisations and their diseases protocols

AHDB dairy is designing strategies to improve animal health and reduce farmers' AB usage practices. They have recently published a mastitis program (AHDB Dairy, n.d.-c) and they have a 'Healthy Feet Programme' available to help farmers improve management techniques that can help reduce the number of lame cows on farms (AHDB Dairy, 2017a). These voluntary programmes serve to influence farmer's behaviour in how they manage their farms and improve animal health. They are designed to govern the quality of livestock management techniques including the use of ABs in dairy. But some of the farmers in this study questioned whether AHDB dairy was too far removed from the lifeworld of farmers to understand what farmers needed.

*"AHDB is a waste of time. It is levy funded but in old terms it is an agency, and it doesn't really reflect real life. We are spending 300 pounds a month, which we can go and get a professional in for a morning on a specific subject and do a one to one. I mean, the AHDB mastitis plan, a bloody waste of time, unless you are really crap at the job and you can't actually deduce where your problem is coming from. But unfortunately, people expect somebody to come along and tell them what to do. And they are prepared to pay over the odds for a magic bullet that they think is going to sort to the problem out rather than doing the plain stuff. Keeping the cows clean and you know, keeping the cows happy and give them a low stress environment."* (Farmer 1).

This farmer also suggested that farmers wanted quick fixes to solve husbandry issues, instead of taking responsibility by themselves. However, as farmers were paying AHDB through a levy, it was suggested that AHDB were therefore constrained in what it could do by the need to deliver what farmers expected (Farmer 1).

### 7.2.4 On-farm staff

The responsibility for disease management in dairy farms is often controlled by the 'herdsman' of the farm. Depending on the size of the farm, dairy farmers will employ a dairy herdsman who is responsible for monitoring and maintaining the health of the dairy herd and may also manage other co-workers on the farm. The herdsman is expected to have knowledge on cattle physiology, reproduction, milk production and nutrition. Farmers are dependent on their herdsman for the management of health and disease of their farm. Vets therefore do not always deal with the farmer but with their herdsman. During the retailer-farmer focus groups, farmers identified the difficulties with this reliance on their herdsman. The farmers argued that their herdsman often had insufficient knowledge of hygiene and lacked up to date medicine

knowledge. In particular, it was suggested that the older generation of herdsman refused to implement new herd health management practices to improve the herd health status, which would then reduce the need for ABs. Farmers suggested that some herdsman worked with their own disease protocols. Data from the retailer focus groups 1 and 2 supports this view.

*“They like to treat animals and are ‘looking for things to treat’. And if they don’t know what to do with it they just jab it with antibiotics.”* (Retailer-Farmer focus group 2, Farmer 11).

### 7.2.5 Peer support

There is a belief, as identified above, that farmers will exchange knowledge and experiences with their peers. Indeed, during the retailer-farmer meetings, farmers discussed with each other their views on the policy initiatives and problems they encountered. Nevertheless, during my fieldwork observation, I encountered farmers who talked about their isolation. Farms were often geographically isolated, sometimes difficult to reach. Bad weather conditions and insufficient infrastructure on farms contributed to isolation. In addition, some farmers argued that UK farmers are competitive rather than cooperative. As one farmer said:

*“Farmers in the UK are very competitive. They know each other’s businesses but do not necessarily work together. We do not share our knowledge, which is different than farmers in other countries.”* (Fieldnotes, Retailer-farmer meeting)

Thus the environment in which farmers lived and worked restricted their ability and inclination to be co-operative. Even though most farmers know their neighbouring farmers and their businesses, they don’t necessarily engage with them.

### 7.2.6 Antibiotics as normalised response to disease

Reynolds Whyte et al. (2003) have studied the ‘symbolic nature of medicines’ in their anthropology of medicines across contexts and argue that to understand the intentions of those who administer them we should explore the ‘perceived efficacies’ of medicines. When medicines enter people’s lives, they do not remain neutral medical objects as the perceived efficacies start to shape socio-material relations (Reynolds Whyte et al., 2003). Although ABs are regulated as prescription only by vets, farmers were (and still are) able to stock pile ABs on farms and make decisions about when and how to administer ABs to their animals independently of vets. Over the decades, the availability of ABs on farms and their therapeutic effects have enabled them to become a farmer’s standard response to herd health issues. ABs

enable farmers to ignore the underlying causes of disease ecologies and move straight to treatment.

*“I suppose it is almost a generation thing. Like dad was brought up with using antibiotics, whereas the next generation, you know, we are moving on now and the next generation will actually think about doing other things, like what we said, ventilation in the sheds that sort of thing. Before it would have been a blanket coverage of ABs really.”* (Farmer 2)

In the context of a busy farm, ABs’ predictable ‘fixing’ properties offer farmers a sense of control over the individual body of the cow, clinical problems and maintenance of its economic value, without necessarily having to engage with the complexity of diseases itself.

*“The problem with farmers is that they think it fixes everything.”* (Veterinary surgeon 3)

It was also suggested that farmers disliked change leaving them reliant upon ABs.

*“The problem is that we as farmers don’t like change and are reliant on the drugs. We as farmers are our worst enemies.”* (Fieldnotes, Retailer-farmer meeting Shropshire)

## 7.3 Antibiotic informants

Jones et al. (2015) undertook a survey of 71 dairy farmers to explore the drivers and barriers to reducing AB-use. They found vets were key sources of information for farmers to reduce their AB-use. RUMA’s task force report (2017) with the Dairy Action Plan positions the vet-farmer relation as the fulcrum for driving responsible AB-use forwards. However, as can be seen in this study, the fieldwork data and interviews clearly indicate that there are additional human and non-human actors that can be identified in the agricultural network of farmers that influence their AB choices. Although vets definitely play an important role, the use of vets by farmers is constrained by other actors and vets are also influenced by their own agricultural networks that shape how they transfer knowledge to farmers.

### 7.3.1 Veterinary surgeons

Vets have contributed over the years to farmers’ belief about the corrective ability of ABs to tackle the disorder of disease.

*“Our vets seem to treat everything with antibiotics, and that is the best way to look at it. You know, what else would you do with the animal otherwise?” (Farmer 2)*

Vets use ABs to manage the uncertainties and farmer expectations that come with diseases. During my fieldwork observations in Veterinary Practice 3, I regularly witnessed some of the vets prescribing an AB to control the situation, rather than wait and potentially risk the health status of the cow. The cows or calves often presented with vague symptoms which the vets struggled to diagnose. ABs were being used to manage the uncertainty of the vet as well as the expectations of the farmers. One vet expressed to me that he would rather prescribe an AB than risk ending up with a bad cow and an unhappy farmer (Fieldnotes Veterinary Practice 3, Veterinary surgeon 10). Previous successful AB treatments of similar clinical situations also shaped the AB negotiation between farmers and vets (Fieldnotes, Veterinary Practice 3). In many cases, vets used the AB that they viewed as the safe intervention; however, this was not always in accordance with good clinical practice. When weighing up the value of the cow and the vet’s reputation against AMR, the vet went for the AB that they felt would work. This decision was often an economic decision, rather than it would make the world ‘a better place’ (Fieldnotes Veterinary Practice 3, Veterinary surgeon 10).

When vets refused to use the AB the farmer expected, farmers would express their disappointment. When I was out with one of the younger vets, he told me how he had previously refused to prescribe a CIA and the farmer had strongly disagreed with this decision (Fieldnotes Veterinary Practice 3, Veterinary surgeon 13). The farmer had phoned the veterinary practice to discuss his disappointment, and openly bullied the vet when we delivered medicines to his farm (Fieldnotes Veterinary Practice 3, Veterinary surgeon 13). In another situation, I observed a vet who was called to a farm to perform a caesarean section on a cow (Fieldnotes Veterinary Practice 3, Veterinary surgeon 12). During the procedure, the vet was about to insert his last suture when the cow panicked and fell on the surgery wound. The farmer was very concerned about the wound getting infected and wanted the vet to give the cow a CIA injection. The vet was, however, not too concerned, cleaned the wound, and gave the cow a non-CIA. When we said goodbye to the farmer and drove away, the vet reflected that the farmer was probably running to his medicine cupboard to ‘top up’ the cow with a shot of whatever CIA he had available.

It became clear over the course of the study that dairy farmers differed in how much they valued veterinary knowledge in relation to disease management and choice of medicines. Some farmers felt very satisfied with their vets and involved them in their decision-making processes related to AB-use and herd health management on farms. They invested in veterinary advice to prevent diseases and to achieve the best results in herd health. Other farmers were,

however, less convinced by veterinary knowledge and only used vets to prescribe them ABs or to deal with complex technical procedures, such as surgery.

*“I think there is also a massive percentage of farmers who genuinely don’t necessarily want to engage in the information and don’t always see it as their problem, because there are some farmers who basically want their vets to sell them drugs.”* (Veterinary surgeon 2)

Some farmers also expressed distrust in veterinary AB-use believing themselves to be more judicious in their use.

*“We manage our own antibiotic use. We only use our vets to prescribe them but we decide ourselves how we use them. My father prefers to make his own decisions as veterinary surgeons are taught to prescribe antibiotics for animal health and welfare, but we have a business to run as well. And vets prescribe too quickly, while our mentality is to prescribe as little as possible as this means less costs to medicines and less problems with milk withdrawal.”* (Fieldnotes, Retailer-farmer meeting Neston)

*“The farmer does not feel that vets are doing much about responsible antibiotic use and argues he does not have much confidence in the honesty of vets who prescribe drugs. He thinks they prescribe antibiotics to earn money on the drugs they sell.”* (Fieldnotes, Retailer-farmer meeting Lanarkshire)

As will be discussed in section 7.4, vets have to engage with several actors in their agricultural network that then shape their AB decision-making.

### 7.3.2 Economic informants: Antibiotic milk withdrawal times and milk residues

What matters to farmers when choosing the *type* of AB to use is that the cow can be put into milk production as quickly as possible while ensuring that the milk is safe from milk residues. Farmers weigh up the milk withdrawal times of ABs. This reflects the time necessary for animals to metabolise an administered product and the amount of time necessary for the product concentration level in the tissues to decrease to a safe and acceptable level. The quicker the milk is safe from AB residues, the quicker the milk can be sold again.

*“The fact that cephalosporins have no milk withdrawal time was actually a really big driver for dairy farmers, and for beef farmers the meat withdrawal. That dictates often what they would want, so even if it would be the right drug to use, they won’t want to use it because of a*

*long milk or meat withdrawal.*” (Veterinary surgeon 17)

### 7.3.3 Antibiotic metaphors

Reynolds Whyte et al. (2003) have emphasised the importance of studying metaphors when exploring how people with non-medical backgrounds make sense of diseases and the medicines that cure them. Reynolds Whyte et al. (2003) observe, metaphors are practical linguistic tools that help people to communicate about experiences they encounter. They enable people with a non-medical background to make disease and medicine effects graspable and exchangeable (Reynolds Whyte et al., 2003, p. 45). Over the decade, CIAs have become constructed by farmers as the ‘big gun’, as they deliver the ‘strongest’ physical recovery which is then translated into economic fitness of the cow in comparison to other ABs.

*“Imagine if I have a calf dying, I want the big gun and not wait and see my costs rising while ending up with a bad cow.”* (Fieldnotes Veterinary Practice 3)

*“The farmers says to me he is worried about stopping the use of CIA, as they are the big guns in the cupboard. He had a case lately that he wanted to treat with marbocyl, a CIA, but he gave it synulox instead. However, the animal responded less well.”* (Fieldnotes Veterinary Practice 3)

Without having to understand diseases or their pharmaceutical mechanisms, CIAs deliver quick and successful recoveries in multiple disease conditions. Where AB policymakers are concerned with the “right drug, right bug, right dose, right route” (Interviews Pharmaceutical Company 1), farmers want ‘the strongest’ drug to manage disease problems.

*“Farmers just see marbocyl as the strongest but don’t understand the pharmacokinetics and where or why the use it for, they just give it a shot.”* (Fieldnotes Veterinary Practice 3, Veterinary surgeon 13)

What further builds the CIA as a ‘big gun’ aside from its therapeutic properties, is that they have a short or no milk withdrawal, contributing to economic efficacy on the farm (as previously discussed).

*“The use of other antibiotics costs us 2-3 days of milking at 2 pence a litre; get money from someone else’s pocket but not from mine! If it costs me my milk than I will keep using CIAs. There are just too much costs involved in longer milk withdrawal periods.”*(Fieldnotes,



Retailer-farmer meeting Preston)

The therapeutic and economic properties of HP-CIAs have driven their popularity in use and have contributed to their construction as the ‘big guns’. AB metaphors enable ABs to move between actors and settings, as they are based on associations with the power of the AB and in which scenarios to use them. During dirty clinical presentations of a sick cow, whether this be a wound, milk, or vaginal discharge, farmers prefer to use a HP-CIA. Very sick cows or calves are also believed to need ‘strong’ treatment by farmers, resulting in HP-CIA use. The economic situation, such as the value of the animal and milk price, contribute significantly to a farmer’s HP-CIA decision-making.

#### 7.3.4 Pharmaceutical companies

Before UK regulators banned direct pharmaceutical advertisement to farmers in 2015, pharmaceutical companies were responsible for distributing information on the therapeutic effects ABs.

*“Years ago, there was a campaign by pharmaceutical companies where Marbocyl was promoted for use in cows with E. coli mastitis. Now everyone knows they don’t really need antibiotics, do they. It is the toxins that are killing them. By definition, the antibiotics are therefore not doing very much. But farmers generally still believe Marbocyl is the best thing for E. coli mastitis and it is really hard to change that.”* (Veterinary surgeon 2)

*“I think one good thing that has changed is that about 2 years ago, you are not allowed to talk about antibioticss to a farmers, unless you are their vet, but still, some pharmaceutical companies would push the boundary. They may not say our drug is wonderful, in front of farmers, but they would have afterwards when people had tea and coffees, they would speak individually to each one and still settle some things.”* (Veterinary surgeon 18)

Pharmaceutical companies also shape the economic value of ABs in relation to veterinary business models. Depending on the number of medicines veterinary practices buy and how loyal they are in their orders, veterinary practices will receive discounts on their orders. Pharmaceutical companies will send sale representatives to veterinary practices to promote products and sell package deals. Veterinary practices are able to make deals with pharmaceutical companies in which sales of their products are rewarded. Importantly, pharmaceutical companies make better deals on ABs than on vaccines, making it more attractive for veterinary practices to buy ABs than vaccines.

*“All pharmaceutical companies have rebate schemes with the vet practices, and these rebate and pricing schemes are unbelievably complicated, and often confuse vets. When the sales vets are going through the schemes with vets, they get the practices better discounts on antibiotics than on vaccines, and I think that is still for the pharmaceutical companies, that antibiotics have better margins on them than the vaccines do. If practices sell much more of this antibiotics, they will get heavily rewarded for it, but if they would do the same for vaccines, they wouldn’t.” (Veterinary surgeon 18)*

Pharmaceutical companies shape the AB behaviours of vets while limiting alternatives to ABs, such as vaccines. In addition, as already highlighted, vets not only receive discounts but also rewards for selling quantities of product. The rewards range from attendance at CPD events in exotic locations to receiving tickets to big rugby matches.

*“There is one company that takes senior vets out to the Lion’s tour, like the big rugby teams. And the countries that the Lions tour in are South Africa, New Zealand and Australia, and they will take 40 vets with them, and they would have like 2-3 hours of CPD, than go on safari, have all their food and drinks paid for and go to games of rugby.” (Veterinary surgeon 18)*

Countries differ in how the pricing mechanisms of pharmaceutical drug selling are legally institutionalised. In the UK, pharmaceutical companies are able to offer discount prices on drugs to veterinary practices. There is no transparency or oversight in the pricing mechanisms of pharmaceutical companies. In contrast, France has forbidden discount prices on drugs by pharmaceutical companies. Prices on drugs are transparent, with the intention to better regulate veterinary medicine markets.

***Respondent pharmaceutical company 2:*** *So in France there are no discounts, the price is the price. It is completely transparent now in France.*

***Interviewer:*** *And that is not the case in the UK*

***Respondent pharmaceutical company 2:*** *No there are still discounts in the UK*

### 7.3.5 Supply chain milk contracts

As discussed in the previous Chapter, milk contracts between farmers and supply chain actors (dairy processors or retailers) dictate the amount and type of ABs farmers are allowed to use. By signing a milk contract, farmers are legally bound to the supply chain AB standards. Vets in their turn are responsible for administering and/or distributing ABs to the farmers that fit with the milk contract of the farmer.

*“Retailer contracts do influence choice in that you need to justify your use. If you know the retailer contract and expectations, you adapt your choices...what is good is that farmers are becoming more open to different drugs. Although you do keep having farmers who say ‘why can’t I use the same drug as my neighbour’ and then you have to explain they are on a different contract.”* (Fieldnotes Veterinary practice 3, Veterinary surgeon 13)

Most dairy sector actors believe that the best way to change farmer AB behaviour and get compliance is to impose financial penalties on non-compliance as the milk contracts do. However, the former quote shows that this will not necessarily improve farmers’ understanding of ABs. At the same time, some vets critique the narrow focus of the retailer AB protocols, shaping social *and* natural orders of AB-use and AMR.

*“Supermarkets are very limited in their antibiotic protocols. They focus on HP-CIA’s restriction but nothing else. This means that if HP-CIA use must be restricted or even stopped on a very short time span, other uses of antibiotics will rise which might impact on clinical resistance to these antibiotics.”* (Fieldnotes Veterinary practice 3, Veterinary surgeon 7)

### 7.3.6 Red Tractor farm assurance standards

The Dairy Red Tractor Scheme requires in its annual Herd Health Plan a medicine record review between the vet and the farmer, including HP-CIA use, AB failures, dry cow therapy and protocols and recommendations on responsible AB-use for the next year (Red Tractor Assurance, 2018). The aim of the Herd Health Plan is to stimulate a discussion between the farmer and the vet about on farm AB-use. It is expected that this will help farmers reflect upon their AB choices and implement the advice that is set out by the vet in the farmer Herd Health plan.

*“So you have farm assurance and they request us to do herd health plans with the farmers. We need to discuss what protocols they have for what drugs and what they are supposed to be using first line, second line for mastitis, lameness and for all these different things. But that doesn’t mean what they do it. In practice, it is always dictated by what goes on in the health plan, as I am sure you know.”* (Veterinary surgeon 5)

The Dairy Red Tractor Herd Health plans deliver on paper what is expected of farmers, although what farmers do in practice may differ. At the same time, herd health discussions tend to focus on what the farmer has done rather than working towards herd health planning that can reduce farmers need for ABs.

*“I think Herd Health Plans probably more often look at “what have you been doing this past year” than “what are you going to do this next year.” Herd health plans tend to be a little less about looking to the future than they should be and they are obviously not bound. But at least there is a little bit of thinking as to ‘this is what the farmers tends to use for this particular clinical situation.’” (Veterinary surgeon 5)*

*“Farm assurance systems don’t care how much you use or what you use, as long as you store it properly. It is supposed to stop people from using antibiotics that are out of date.” (Fieldnotes Veterinary Practice 3, Veterinary surgeon 11)*

### 7.3.7 Antibiotic surveillance mechanisms

AB usage data collection is believed to represent ‘evidence-based’ information providing transparency in AB usage activities. Currently, electronic dairy AB *usage* data is available for roughly one third of the national dairy herd (UK-VARSS, 2018). This data stems from the UK dairy Farm Vet System, which is a veterinary data set that collates delivery data to dairy farms from Practice Management Systems. It covers over 3000 farms which accounts for 33% of the UK dairy industry and is used by industry policymakers to evaluate dairy *veterinary AB usage* data (UK-VARSS, 2018). Some major UK retailers have set up their own data bases of AB data collection through which they can monitor and benchmark farmer AB usage. This data is, however, not synchronised with other data sets but used for retailer farmer AB benchmarking purposes. There is as such no unified national digital AB surveillance system available yet in the dairy industry at veterinary and/or farmer level (in contrast with the pig and poultry industry). There is a growing critique about the trustworthiness of the AB data collection systems itself.

*“In our practice, stock is very well registered. However, in my former practice, there was no control at all. What is in your car or not, they did not bother. Farmers register their own use, or they ‘should’ do. There is a variety in registering drugs in both vets and farmers.” (Fieldnotes Veterinary Practice 3, Veterinary surgeon 11)*

The vet in the above quotes argues how some of the vets and farmers fail to accurately register AB usage activities. Although policymakers believe surveillance data represents AB practices, the practices of antibiotic policies differ from numerical realities.

### 7.3.8 RUMA guidelines

Although RUMA positions itself as an industry lead, adoption of their guidelines by veterinary practices and vets is not a straightforward process. Most of the vets I encountered had heard of RUMA and their guidelines. Some of the vets had actively read the RUMA protocols and appreciated their content.

*“We have discussed selective dry cow therapy, which is RUMA, and I think most of us have read that, because it actually is a reasonably practice document. It has recommendations which are basic. It’s got your three recommendations, and I found that quite useful.”* (Veterinary surgeon 2)

However, other vets chose not to work with the RUMA guidelines and some did not have knowledge of them.

*“I have not really heard of initiatives of RUMA.”*(Fieldnotes Veterinary Practice 3, Veterinary surgeon 8)

*“It is good to have a controlling body that sets antibiotic standards to refer to or look up if needed. But I find they are too far removed from practice. We define our own antibiotic protocols.”* (Fieldnotes Veterinary Practice 3, Veterinary surgeon 9)

Guidelines and protocols are often produced with the intention to influence the decision-making capability of individuals (Berg, 1997). However, by advising individuals to take sequential step by step actions, the protocol ignores contextual factors at play that drive processes of individual and collective action (Berg, 1998). This not only results in a discrepancy between protocol intentions and practice, but also an ignorance of the protocol as expressed by Veterinary surgeon 9.

## 7.4 Tensions between antibiotic prescribing and dispensing

As I have been highlighting, the veterinary prescribing-dispensing-administration of ABs has become more than an evidence-based therapeutic act. Although veterinary ABs in the UK are on a prescribing basis only, farmers are able to administer ABs to their animals without the intervention of a vet. In turn, veterinary industries are able to dispense ABs to farmers without

always having to perform a physical examination of the animal/herds. Consequently, farmers have their own medicine stock on their farm, which is beneficial to both professions: farmers are able to manage their own herd health while vets earn money on the medicines they sell. Instead of exclusive veterinary objects, ABs have become part of a farmer's toolkit, used to manage all types of herd health problems on the farm. In what follows, several 'actors' will be discussed that co-construct the commercial route from prescribing to dispensing.

#### 7.4.1 The demystification of the prescription

In human medicine, the prescription represents an act of communication between the patient and the practitioner. The prescription as a 'script' represents the expertise of the practitioner through which the patient can receive medicines that will make him or her better (Reynolds Whyte et al., 2003, p. 124). The medicines themselves are 'tokens of concern' that are symbolic representations of the doctor, which add to the perceived efficacy of medicines by patients. As Reynolds Whyte et al. (2003, p.124) argue, the prescription and the medicines are metonymic extensions of the doctor. The authority of the doctor is present all the way through the process from reviewing the symptoms of the patient, who is physically in his/her practice to the doctor's clinical examination, through to the administration of the prescription and the medicines. This reassures the patient that he or she is being treated within the conventionalities of medical expertise. The medical pathway, therefore, involves a physical interaction between the key actors: the patient, the doctor, and the prescription that contains the medicines.

As previously discussed, ABs can be prescribed over the phone by vets to farmers, unlike practice in human medicine. In these cases the prescription is mostly an administrative act for the official medicine record for the veterinary practice. This practice blurs expert boundaries between the veterinary profession and the farmer. Moreover, farmers *expect* vets to prescribe ABs. Equally, for vets the prescription represents a business transaction rather than an expert intervention. By prescribing, they are establishing a particular relationship with their farmers and most importantly, maintaining this relationship. If vets refuse to prescribe ABs at the request of farmers, vets could lose their client to other vets in the same practice or to other veterinary practices.

*"It's the difficulty of if someone's ring you up and says, 'I need these tubes X, Y and Z'. Most people would be like yeah, that's fine, sign the prescription, and if you then start asking too many questions the farmer might get pissed off and might call in at another time when another vet is there, because all they want is their same order of antibiotics."* (Veterinary surgeon 18)

The prescription as metonymic expression of veterinary expertise has lost its symbolic power.

*“Farmers can generally find ways around prescriptions.”* (Veterinary surgeon 3)

*“In the UK, obviously the farm culture is very much to have a stock of drugs on farm, which is largely down to their choice on how they are given. Obviously, they have to have things like a Herd Health Plan, they have to have theory advice from their vets on how to use antibiotics. But in reality, er, as you probably know, they choose what they do with those drugs. And sometimes what they do is, er, at the very least inappropriate and sometimes disturbingly creative. So, I think it would be nice to see vets, sort of, strengthening their position to provide a lot more restricted access to medicines, only with, not necessarily going in to administer on farm, but to have a lot more control over, or be forced to take a lot more control over what they are used for.”* (Veterinary surgeon 20)

The prescription is officially the only barrier to farmers to get access to ABs. Once prescribed, ABs circulate freely. As discussed, there are no clear policing systems in the dairy sector yet that can track record the destinations of antibiotics. Farmers can experiment themselves with the repertoire of ABs held on the farm.

#### 7.4.2 Blurring of expertise boundaries

As discussed vets appear to have lost control over ABs as objects of their expertise. Fournier (1999, p. 70) has extensively discussed how professions gain their authority by ‘isolating’ knowledge about their objects and techniques of expertise. Through their own fields of knowledge, professions build their ‘authority and exclusiveness’ (Fournier, 1999, p. 60). Boundaries between professions and clients are established by making professional practices rather a ‘mysterious’ act and as such inaccessible to clients/lay people and clients (Fournier, 1999, p. 75). But when the boundaries of professions are dismantled by clients and markets, their goods and services becomes available to these groups which shifts the professional boundaries of expertise (Fournier, 1999). Due to the accessibility of ABs to farmers and their widespread use as economic tools in agricultural systems, vets have been unable to maintain monopoly on ABs as their fields of expertise. With farmers trusting their own AB protocols, vets negotiate AB actions with farmers rather than dictate what to use and how to use them.

*“I had a client recently who, I was there for something else and he said, “while you are here can you see a calf with pneumonia” and he said that it needed some Micotil. I was like, ‘I don’t think it does actually. Have you given it anything’? And he said ‘Yes I gave it some Alamacyne, so ehm Oxytetracycline, I gave it 10cc’. And I was like, ‘ So that is enough for a*



*100kg calf, this is a 250kg calf', 'Yes but it was all I had'. Ok. 'And then I gave it some Resflor'. 'How much Resflor did you give it'? '5'. 'So basically that is less than a 50kg dose and now you want me to give it some Micotil 12 hours later'? We agreed that he could have more Alamycin, a full dose of Alamycin, you know.'* (Veterinary surgeon 2)

I observed farmers requesting additional ABs of certain types as they were 'running out' of stock. This was in most cases agreed upon by vets, with some vets asking for more explanation than others. Another route through which vets lose control over their expert knowledge and practices is by delegating the management of common herd health problems to farmers. Farmers were given authority by vets to self manage certain issues, such as superficial wounds or lameness issues. Whenever farmers consulted vets, on the phone or on the farm, vets were often asked by farmers to prescribe a couple of extra bottles of ABs in order for farmers to self-manage 'easy' problems. Consequently, farmers were not only able to take over the part of the expert role of vets but were also allowed to get ABs prescribed.

*"I suppose the vets in the UK, in the way that they prescribe, it is a bit of an unusual one because you prescribe for...let's say you get called out to see a sick cow, you would write a prescription for that sick cow per cause and likewise, you would probably prescribe a prescription for let's say, 5 bottles of penicillin to keep on the farm so that the farmer has something. If there is something that needs to be treated, that does not warrant a vet to be called, for like a lame cow, or a cow that had cut himself, than the farmer can use it without having a vet called out. Or if you were out on the farm for let's say, your fertility visit, you would potentially leave a few bottles of drugs there, that you would write a prescription for, but you would not necessarily know what really...what happens with it... that would be an exceptionally difficult thing to try to change because the farmers are so used to it being, as it were, in control of their drugs... yeah I think if they had to call out a vet for every single time they needed an antibiotic they would just stop calling the vets."* (Veterinary surgeon 17)

The AB interventions themselves also stimulate the blurring of boundaries between farmers and vets. Many training and educational programmes have been designed to teach farmers how to use ABs 'safely'.

*"There is a lot of initiatives going on about trying to train farmers in how to use medicines on farms. I am thinking...well that's not, you know, yes that's fine, and the vet should actually be, it is his responsibility actually to ensure they are used properly on farms."* (Retailer 1)

Vets also critiqued the expert knowledge of agricultural consultants who are increasingly used by dairy supply chain members such as the milk processors and retailers, who help farmers



with their cost-production farm models.

*“There are at the moment too many consultants with too many different stories and different tick boxing to do. The Promar guys and Kite who are the agricultural consultants that work for Tesco are young guys who don’t know what they are talking about. During one of their talks at a farm where a colleague was as well, they give very basic information, which was quite embarrassing.”* (Fieldnotes Veterinary Practice 3, Veterinary surgeon 7)

An important recurrent theme was the veterinary concerns about the drug dependent nature of their business model. Veterinary consultancy fees are relatively low and the geographical dispersal of farms means that travel consumes a large proportion of each day, constraining their ability to generate revenue other than through sales.

*“Vets are kept responsible by policymakers and the industry as we earn a lot of money on medicine. In the meantime farmers expect us to give them free advice. Yes indeed, 30-40% of our income is medicine, but look at our hourly rate: 120 pounds and a start fee of 30 pounds is 150 pounds an hour in comparison with other consultants who earn 300 an hour.”* (Fieldnotes Veterinary Practice 3, round table discussion with partners)

*“Of the 10 hours we work only 3 hours is effectively charged to the practice.”* (Fieldnotes Veterinary Practice 3, Veterinary surgeon 13)

Vets felt they had little scope to change their business models from a drug-fee financed model to a consultancy-fee financed model due to farmer pressure and competition with other practices. Farmers expected vets to give them free advice over the phone or prescribe ABs at their behest. The freedom of farmers to choose their veterinary practice on the basis of the best medicine deal and/or drug prescribing policy was reported to create price wars between veterinary practices as they battled to sell the most drugs for the cheapest price. In this context farmers were free to shop around to achieve the best deal.

*“How do you say to someone who perceives their vet as a shop, which some farmers do, you can’t have this you know. That has to be regulated because there will always be that practice that is willing to give it out.”* (Veterinary surgeon 2)

Vets and their practices were reported to feel trapped in their economic power relation with farmers.

*“One of the major problems I think exists at the moment is that drugs are used as a threat by*

*some farmers. So, farmers have an idea of what they want. If the veterinary practice puts restrictions on- for example, says, "Right, I'm afraid, no, you can't have six bottles of, er, marbofloxacin because that's not an appropriate use. It's a critically important antibiotic that we want to reserve," etc. etc., the farmer only has to go to the next veterinary practice down the road and say, "Will you give it to me?" and suddenly they've lost that business. And there is no doubt that that is a huge concern for a lot of vets who I've spoken to. Many of them feel like they're held over a barrel." (Veterinary surgeon 17)*

Many vets reported that farmers were not interested in the veterinary advice that comes with AB prescribing, contributing to a lack of oversight with what happens to ABs once they are in the hands of the farmers. As a result of this ease of access and lack of oversight, the vet in the following quote argues how ABs have turned into commodities to farmers, rather than therapeutic objects. Farmers feel entitled to buy and to administer ABs, without understanding how to actually use them.

*"Farmers see antibiotics as commodities, they have lost all therapeutic value to them. They don't enjoy other opinions and if they buy medicines they feel they have the right to use this medicines. A problem is that farmers have no idea of doses and compliance, which then impacts again on resistance." (Fieldwork Veterinary Practice 3, round table discussion with partners)*

I previously discussed the therapeutic value of HP-CIAs to farmers. The therapeutic value of CIAs to farmers is that it gives a quick, reliable recovery with cows quickly available for milking again. What matters to farmers is that they have an easy accessible tool to quickly cure their sick cows. However, farmers lack the knowledge of what the HP-CIA is for and for which situations it is actually meant to be used. To vets, the therapeutic value of ABs is more than just delivering cow recovery; it represents expertise and knowledge practices of how to use the AB in each situation.

Vets discussed the tension between the commodity status of ABs to farmers and ABs for them as objects of expertise. Losing control over their objects of expertise appeared to vets as de-professionalising the veterinary profession and ultimately contributing to antimicrobial resistance. In addition, the veterinary dependency on drug income can cause conflict between their professional duties versus their economic interest.

*"I think it's an odd relationship that most practicing vets in the UK have with drugs, because they are dependent upon their, their sale for income, but at the same time, ultimately, most vets are motivated by a professional interest and the science is held in higher regards than the sales. So as long as they feel that something's appropriate, and there's a good, scientific evidence for it, and it might be that their, their thresholds for scientific evidence might be a bit*

*low, but they won't consciously, I think, prescribe a drug that they didn't think was necessary.”*  
(Veterinary surgeon 20)

During my fieldwork, younger /newly qualified vets reported on more than one occasion that veterinary practices financially incentivised veterinary surgeons to sell ABs by providing them with a bonus if the sales of ABs reached an identified level.

## 7.5 Farmers' access to antibiotics

When farmers need ABs, they can either order them over the phone with the vets/veterinary practice or farmers can go themselves to the veterinary practice. Although dispensing rules in many veterinary practices are becoming stricter (no more dispensing of CIAs to farmers), farmers can still enter a practice at any moment and ask for ABs. The receptionists or veterinary assistants will often dispense the ABs based on the previous records of the farmer and the types of ABs they ask for. Officially, receptionists need to discuss the request of the farmer for ABs with vets. What may happen in practice is that receptionists will dispense the medicines farmers ask for with prescriptions signed retrospectively by the veterinary surgeon. Differences exist between veterinary practices and individual vets in how they work with receptionists.

*“Say it is about 10-11 o'clock in the morning, all the vets are out doing visits, you have got the receptionist staff there, a farmer comes in, and says...or is on the phone.. 'I need X, Y Z' and the receptionists would write things down, and then, it would totally depend upon the practice of what happens next. Some practices would ring a vet up, and be like, 'Mr. Jones has rang up and ordered X, Y and Z, is it ok for him to have it?' and verbal consent on the phone is enough to prescribe and then they will sign the prescription later when they are back in. Or other practices will wait for a vet to come back into the practice, to do it properly, or like I said earlier, the receptionist in that one branch, the receptionist would just have given those drugs, and then got the vet to sign it later, so they were dispensing without any authority, but they knew that the vet would be quite happy to sign it later.”*(Veterinary surgeon 18)

Veterinary assistants, in some cases, also take on an 'expert role', advising farmers what to use.

*“Where I was working, there were 3 branches, and in one of the branches, the receptionists would prescribe drugs, and I caught them doing that and obviously told them off, but they'd obviously been doing that for years, and the vet in that branch had no problem with them, and they were giving the farmers active advice of...if this antibiotic tube isn't working, use a different one, and they didn't see anything wrong with what they were doing. So I think to change THAT culture would be really quite...difficult.”*(Veterinary surgeon 18)

Farmers were reported to be aware of the prescribing and dispensing mechanisms in veterinary practices and sometimes used this knowledge to get the drugs they wanted.

*“My last practice where I worked, farmers called the girls and they asked for Marbocyl because they had an E. coli mastitis, as they knew that this was going to get them the drugs they wanted. Vets then only sign the prescription retrospectively. Farmers were able to buy drugs in bulk orders. That still happens as well in this veterinary practice. It was not recorded properly either. Farmers can get it online as well. They just don’t understand the pharmacokinetics, but if they want it they will get it.”* (Fieldnotes Veterinary Practice 3, Veterinary surgeon 11)

Online pharmacies have become an important actor in farmer AB transactions. These online pharmacies are either run by veterinary corporations or pharmaceutical companies. Although the ABs need to be prescribed by the responsible vet/practice/corporation who run the pharmacy, there is a lack in oversight over what happens with the drugs after prescribing.

*“The existence of online pharmacies, I don’t think they help the prescribing process at all...as the farmer can go on there and create his shopping list, of what he wants, and then, well there still needs to be prescription at the end of it. So I think, how it currently works, is that the local vet authorizes the farmer that they can use it and signs a general prescription for everything that has to be done once a year. The farmer orders whenever they want, and there is a vet that works for the online pharmacy that signs each order as a prescription. I just can’t see how this is helping...at all [...] the farmer can just shop and change, choose what he wants, without any understanding necessarily of the differences. So, for example, like vaccines, he could decide to use one year one IBR vaccine and next year the other, because one’s cheaper, without necessarily...he won’t start the course properly again, he won’t know the slight differences between them, and...likewise with antibiotics, he may just choose what is on offer. There will be a vet signing it along the way, but, yeah, and I have never agreed with it, because I don’t think, it is not right. I think...it’s the...there is a complete loss in...well they claim there is still control but I think there is a loss of control, because the farmers on the whole are signing up for it. So there is one practice that owns it, and all their farmers have to use it as their ordering system, but other, like, farms who are not members of this practice can, freely use it, if they want it, and I think those farms they have then less contact with their vet, because they are going to the website to get drugs. They are getting less health advice, and obviously the, that website is just there for profit, nothing else.”* (Veterinary surgeon 3)

Another important access route of ABs to farmers are other farmers in their networks. This could be either neighbours or actual off the record trade.

*“We hear that farmers are buying antibiotics from other farmers as well. Because, you know, one farmer might get 100 bottles from his own vet but then sell on some to another farmer.”*

*And that is really difficult to police. I guess the thing is, you have people buying drugs from wherever they are getting it.” (Veterinary surgeon 3)*

*“There will always be that person who says ‘oh you can have some of mine’ and there are farmers who import it from Ireland as well” (Veterinary surgeon 2)*

As a result, various AB access routes enable farmers to stock ABs on their farms. This is confirmed by a recent ethnographic study performed by Rees et al. (2018) on the content of medicine cupboards on farms. The authors undertook a qualitative study to study the knowledge gaps surrounding prescribed veterinary ABs and farmer’s decision making about AB treatment in the absence of vets. The aim was to study whether veterinary medicines are used by farmers in the way the prescribing vet intended, or if there are other influences on post-prescription use. Data was collected from 27 dairy farms in England and Wales in the autumn of 2016, during which medicine cupboards were audited. The cupboards stored a broad range of different antimicrobials, with a median of 9 injectable antimicrobials. One of the most frequent kept antimicrobials was Ceftiofur, a HP-CIA for humans. A large number of the farmers had expired antimicrobials, some of which were over 16 years out-of-date, but were still intending to use them. It was also found that the quantity of antimicrobials stored by farmers was not linked to the number of animals at risk of treatment, suggesting there were other reasons for the storage practices found (Rees et al., 2018). I observed similar findings in my fieldwork. Although I was not able to always look into the medicine cupboard of farmers, most farmers’ stored antimicrobials on their farms. Whenever an AB was prescribed, the vet always asked if the farmer still had enough stock of the prescribed drug.

## 7.6 Discussion/conclusion

The ‘misuse and overuse’ of ABs in agriculture has been reduced to a behavioural problem by UK policymakers: farmers and vets are blamed for their deviant AB practices and/or ignorant AB knowledge. Appropriate training and support is believed to encourage the uptake of responsible AB practices and to strengthen the vet-farmer relationship (RUMA, 2017). Protocols and guidelines are implemented to support veterinary and farmer AB-decision making. Problematically, these interventions ignore the complex agricultural networks in which ABs circulate. As discussed in this Chapter, AB decision-making is more than an individual act. I identified 4 important actor-networks that ‘co-produce’ how ABs are prescribed, dispensed and ultimately end up in animals.

First of all, *disease informants* shape the decision about whether ABs will be used by farmers or not. Lay disease protocols, veterinary phone calls, farm staff, and ABs as normalised response to diseases on farms co-constructs farmers decisions. These actors tend to overrule evidence-based protocols, such as AHDB disease protocols. Second, *AB informants* influence what type of AB will be used: the vet-farmer relationship, AB metaphors, the AB milk withdrawal time, milk contracts and pharmaceutical companies have been identified by informants as influential. In contrast, the Red-Tractor Standards, AB surveillance systems and RUMA guidelines have had less impact on how ABs end up being used in dairy cows. These evidence-based standards and protocols were either partially adopted or ignored. Third, *tensions between veterinary prescribing and dispensing* affect the AB pathways. The act of veterinary prescribing has become a formality rather than an act of expertise. Most farmers expect vets to prescribe the ABs they want. As a result, vets feel under pressure to either prescribe or risk losing the client. This limits the ability of the veterinary practices to change their business models from drug financed to consultancy financed models. Fourthly, farmers have various *AB access channels* through which they can get ABs prescribed and/or dispensed. There are multiple veterinary practices to choose from, who are willing to prescribe. It was also found that: veterinary assistants contribute in the veterinary prescribing-dispensing process; there is an increasing availability of online pharmacies linked to veterinary practices or pharmaceutical companies; farmers dispense to other farmers; and finally, it was suggested farmers sometimes import medicines from abroad.

This Chapter discussed how actor-networks of ABs constrain farmers and vets in their ability to change their AB-use. A major issue of concern identified in this research is the access to drugs by farmers and their ability to stock them on their farms. This empowers farmers, trusting their own expertise, but results in difficulties in transferring knowledge. Using Chandlers and Hutchison's (2016) concept of antimicrobials as 'infrastructures', I argue that antimicrobials have become integral to farmers understandings and practices of animal health and animal performance. ABs are embedded in the daily practices of farmers, supported by a vast array of human and non-human actors that confirm their importance. As a result, vets are unable to reclaim their exclusive expertise over ABs, and remain dependent on their income from selling AB. Educational strategies and training programmes will have a limited impact in changing farmers' behaviour, as long as these antimicrobial infrastructures remain intact.

Importantly, these economic actor-networks have already proved to be resistant over time to voluntary policies that focus on behaviour change. Instead, policymakers should address their gaze towards the structural issues on farms and in veterinary practices I identified in this Chapter. By understanding what actors drive AB-use, policies can be better targeted at these actors. Empowering farmers in their AB knowledge could result in unwanted effects, such as

farmers feeling even more entitled to contribute to AB decision-making. Instead, we need to first understand what actors drive farmer AB decision-making in the first place and address these structural problems. Second, we need to tackle farmers' access to ABs and their ability to stock ABs on farms. Third, vets need to be supported in their business model transition by regulations that re-distribute authority over ABs to farmers. Fourth, the government should reconsider legislation around medicine pricing by pharmaceutical companies.

The next and final Chapter will discuss the findings of this thesis in more depth, elaborate on the policy interventions proposed and the public health implications of the findings.

## **Chapter 8**

### Discussion and conclusion



## 8.1 Introduction

With AMR as one of the most complex public health risks of the 21st century, human and animal AB-use has been internationally problematised to define urgent areas of action. The central issue, with regard to both humans and animals is *how* to reduce AB-use. Since ABs are used by farmers and veterinary surgeons, international and national policy narratives have focussed on the ‘misuse and overuse’ of ABs by these particular actors. In 2016 in the UK, the O’Neill economic expert committee, UK governmental policymakers and agricultural policymakers consolidated around a voluntary industry-led approach to achieve responsible AB-use. By framing the use of AB-use in food producing animals as ‘excessive’ the problem became calculable and amenable to intervention. This resulted in technocratic interventions, such as the installation and standardisation of AB surveillance systems, AB guidelines and educational strategies to ‘rationalise’ farmer and veterinary AB-use. Consequently, agricultural policy, education and research responses have focused less on the workings and needs of livestock industries themselves, and more on quantifying AB usage and sales activities, to deliver public evidence of ‘progress’.

This study questioned the ‘misuse and overuse’ policy frame in favour of studying how responsible AB-use was executed from within the inner workings of the UK dairy industry. Instead of studying farmers and veterinarians as ‘the problem’, I studied responsible AB policies and practices in the UK dairy industry as a socio-material agricultural network activity. I showed how tensions between policy and practice emerge, and the overflows this generates. In the dairy AB-actor networks, responsible AB-use was found to be a negotiated and embedded process, contingent upon associations or ‘assemblages’ (Latour, 2005) of dairy actors and their relationships within dairy supply chains. These included government and dairy AB policies, milk producers, staff, husbandry procedures, diseases, milk quality, milk safety, udders, hygiene procedures veterinary surgeons, veterinary business models, pharmaceutical companies, milk processors, milk residues, MRL levels, AB self-tests, consumers, labels, farm assurance, national milk recording, medicines books and more. Together, these human and non-human actors defined how farmers, veterinary surgeons, and dairy supply chain actors performed responsible AB-use according to what mattered in their ontological surroundings. This illustrates that AB-use in the dairy industry is less of a behavioural problem; resulting from ‘cultural drivers’ that produce ‘irrational’ AB-use. Instead, choices in dairy AB policies and their performances are the result of collective actor-network activities, with humans and non-humans defining action.

Understanding dairy AB policies and their practices as actor-network activity has ontological implications. Dairy AB policies and their practices also ‘co-produce’ new social and natural

orders of AMR, thereby potentially producing new public health risks. Taking ABs as centres of interest and studying their ethnographic trajectories, I have provided an important methodological, conceptual and practical re-interpretation of livestock AB-use as a ‘problem’, which has to date isolated understandings of AB-use in terms of farmer and veterinary behaviours. I will discuss these findings further firstly, by examining how the UK’s political culture has come to such a limited understanding of how to govern responsible AB-use and secondly, to explain how this has led to the production of particular supply chain-led AB policies in the UK dairy industry. Finally, I explore the wider contribution of this research to the complex area of AB policy governance.

## 8.2 Implications of international framings

The international narrative of AB ‘overuse and misuse’ in agriculture has shaped the UK’s industry-led AMR strategy. The adoption of the international narrative, I would argue, has removed the need to question the inherent assumptions and commitments within this narrative (Wynne, 1992, p. 115). This thesis has demonstrated that, although selectivity and cultural conditioning are inevitable in the construction of policy frames, certain knowledges are prioritised over others (Jasanoff, 2005b, p. 25). With the WHO consistently framing AB ‘misuse and overuse’ in agriculture as the main risk from the late 1990s onwards, it has become normalised across political, scientific and public settings to blame the users of livestock ABs as the main problem. The ECDC, EFSA and EMA published a report in 2015 in which they linked quantities of AB-use in humans and animals with increased risks of AMR. In some cases, they found a positive link between AB consumption in animals and resistance in bacteria from humans. The increasing need for AB surveillance data has pushed nations to either implement or improve their human and animal AB surveillance systems.

Problematically, AB surveillance data, on which organisations such as the WHO, ECDC, EFSA and EMA rely to make claims on the impact of policies, tend to provide only a snapshot of the totality of the story (Jasanoff, 2016). Internationally, the available data on animal use is based on pharmaceutical veterinary sales data (ABs sold to veterinary practices). AB sales data does not provide any insight into how ABs end up being used by vets and farmers. AB sales data leaves important actors out of the understanding of AB-use. Key actors left out include, pharmaceutical product interests, food supply chain agreements, husbandry systems, trade positions, governmental support to local agricultural systems, the existence of national knowledge institutions (universities – industry – consultancy – NGOs) and their alignment with agricultural sectors. Moreover, classical risk assessments, used by the WHO, ECDC, EFSA and EMA to study trends and patterns of AB sales activities across countries perform

new ontological practices; by deciding what versions of progress come to matter and which are excluded, they shape new social and natural orders of AB-use and potentially, AMR.

### 8.3 The role of science in the UK's governance of antibiotic use in agriculture

As discussed in Chapter 4, the human and animal AB 'misuse and overuse' narrative became the centre of attention in scientific, political and media discussions in the UK. The O'Neill expert committee (2014-2016) was appointed by the UK government to deliver impartial evidence and a fresh perspective on the social and economic consequences of the issue and in so doing de-politicise concerns. Criticising the 'excessive' use of ABs in agriculture, these economic experts used the 'built-in' assumption (Wynne, 1992) of international narratives that the users of ABs are the main concern. This resulted in a self-fulfilling prophecy: the O'Neill 2015 report performed a systematic literature that focused on the measurable aspect of AB-use. Instead of interpreting the boundaries of the established 'misuse and overuse' WHO policy frame in the first place, the systematic literature contained explicit assumptions on the 'misuse and overuse' of ABs in agriculture. A complex problem was reduced to a binary question: is the 'excessive' AB-use in agriculture a risk to human health? The problem was made governable and calculable. Scientific legitimacy became the basis for UK political decision-making around agricultural AB-use. The 2016 O'Neill proposed three main pillars in the transformation of excessive use in agriculture into responsible use: AB reduction targets; AB measurement, and; AB education around use and alternatives. These responsible AB-use policy pillars (O'Neill reports; 2015, 2016) were adopted by governmental and agricultural policymakers, but the UK livestock sector was made responsible for implementing the recommendations and developing AMR strategies to tackle misuse/overuse of ABs.

In Chapter 4, I also demonstrated the existence of competing concerns in livestock AB-use across political and agricultural settings. These concerns influenced how evidence about livestock AB 'misuse and overuse' ended up being used to inform political debates. For instance although the 2015 O'Neill report recommended regulation, taxation of ABs and/or subsidies of alternatives to support policy, these recommendations were not adopted by governmental and agricultural policymakers. AB legislation such as delinking vet payments and profits from prescribing ABs was not favoured by either the UK livestock industry or the government. Demonstrating how commercial interests and political interests can become aligned, I will elaborate next on how the process of framing is situated in a nation's political approach to science governance. Who frames livestock AB-use as a risk and how evidence is

negotiated and by whom matters; this framing provides insight into how nations deal with uncertainties and what gets lost or simplified in the process.

## 8.4 Dealing with uncertainty: the expert-lay gap in the UK's political culture

In Chapter 3, I showed how the Swedish consensus-oriented policy culture framed the risks of agricultural ABs differently from other countries, from the 1980s onwards, by taking a precautionary risk approach towards livestock AB-use. Instead of waiting for more scientific evidence to clarify the uncertainties involved with AGP-use, the Swedish government broadened the discussion incorporating different views and multiple concerns beyond those of the scientists. Taking into account farmer, veterinary and consumer concerns, Sweden undertook a precautionary approach and banned AGPs in 1986, instead of waiting for more conclusive evidence. This was in contrast to other countries, in which dominant groups such as pharmaceutical and agricultural lobby groups used the absence of conclusive evidence to continue with AGP-use. Today, we find in Sweden a strong collaboration between the Swedish government, farmers and vets, working together to improve the agricultural sector collectively.

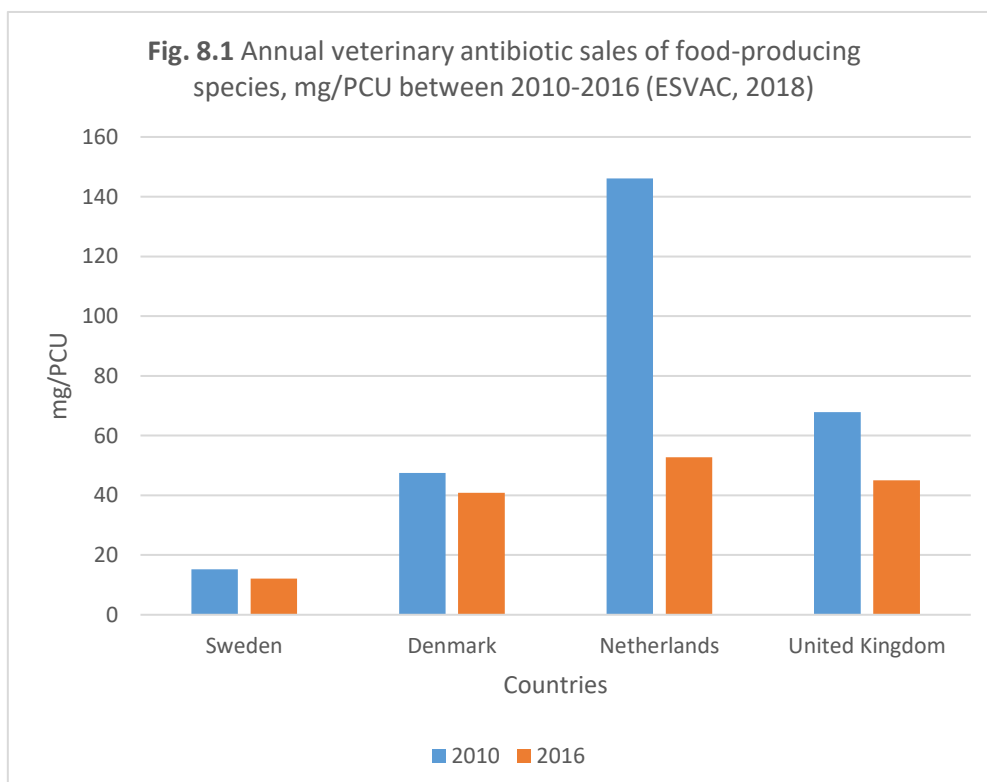
Callon et al. (2009, p.192) emphasise the usefulness of taking a precautionary approach to uncertainties involved with technological risks. They argue it offers an 'active, open, contingent, and revisable approach' and is 'exactly the opposite of a clear-cut definitive decision' (Callon et al., 2009, p. 192). Precautionary approaches give the opportunity to deepen knowledge, taking into account views beyond scientific disciplines. Indeed, the Swedish government democratically used complementary kinds of knowledges to identify danger and define precautionary action. In the UK, experts, government (DEFRA, VMD) and agricultural policymakers (RUMA) 'collectively' assessed 'evidence' of the O'Neill reports (2015, 2016). The debate was, however, not opened up to extensive public review and alternative voices. UK policymakers deferred to established experts and institutionalised spokespersons of the agricultural industries, effectively distancing any other concerns

I showed how the UK still heavily relies on expert committees to assess risk, rather than opening up the scientific debate to lay publics. In the UK's governance of livestock AB-use, farmers and vets are controlled by the world of the specialists, who keep their monopoly on the production of knowledge. Specialists (researchers and agricultural representatives) have the task of producing 'objective' knowledge by implementing technologies that will tell us what to do (Callon et al., 2009, p. 43). The UK's industry-led policy model has come to rely on the exclusiveness of science and its methods to govern the issue of agricultural AB-use.

This belief in scientific progress, creates a false belief that science and its methods are able to provide us with accurate information (Jasanoff, 2016). The limitations of trusting scientific methods to drive change *and* evaluate policy impact will become clear in the next paragraph.

## 8.5 The ‘thin’ reality of surveillance data

The quantification of AB sales and use has become central in national and international discussion: metrics are used by policymakers to inform policies and evaluate the impact of these policies. In the UK, the latest UK-VARSS 2018 report claims significant reduction in AB-use across and within livestock sectors. From 2013 onwards, the UK has achieved a 40% reduction in veterinary sales (sold by pharmaceutical companies to veterinary practices). Within the dairy industry, the veterinary usage data shows a reduction of 35% between 2016-2017, although the percentage only represents 30% of the total dairy veterinary community (UK-VARSS, 2018). The latest data available on veterinary sales data across 30 European countries over 2016, in mg/Population Correction Unit (PCU), shows a large difference in sales between the countries (EMA, 2018). Between the most-and least-selling country, a range can be observed from 2.9 to 434.2 mg/PCU, with an average sale of 135.5 mg/PCU. Comparing Sweden, Denmark, the Netherlands and the UK (see Fig. 8.1), they all rank below the European average sale of 135.5 mg/PCU, and have achieved reductions in veterinary AB sales 2010–2016 (EMA, 2018).



Importantly, the data presented in Fig. 8.1 is veterinary antibiotic sales data, based on pharmaceutical sales to veterinary practices. There is still a gap in knowledge across European countries about their veterinary and on-farm AB usage data. Nevertheless, according to the data, the UK appears to be one of the better performers in Europe in terms of a reduction in AB sales. However, this data is sales data and does not say anything about responsible use. Nevertheless, this numerical evidence of AB reduction is both *trusted* and *used* by scientists, governmental and industry policymakers to claim progress and settle controversial debates.

However, what is not taken into account in the previous data is the complex interactivity between science and human's, which became 'visible' during my fieldwork. In 2016 the dairy industry was left in charge of implementing a sector surveillance system. This resulted in a rather chaotic approach. While the dairy sector was and still is debating how to design an overarching system, supply chain members had already started to implement their own AB usage systems. With different 'expert' teams in charge across supply chain members, different systems circulated, producing a lack of transparency on how the AB data are collected, processed and evaluated. In addition, the Red Tractor Dairy Farm Assurance has its own 'medicine book' system, which requires farmers to provide written or digital medicine recording and is evaluated on an annual base. With different AB usage systems circulating in the UK dairy industry, designed by different groups, collected through various routes, and analysed by different expert teams, there can be no certainty about the nature of the data used to report a reduction in AB-use. As Jasanoff (2016, p. 58) asks, 'can numbers capture the accuracy and reliability, or the honesty of the suppliers of the technology or of the information needed' to assess a situation properly?

At the same time, I have evidenced in Chapter 6 and 7 how AB surveillance data only partially represents practice. Moving beyond boundaries of science and its policy matrix, I found that medicine recordings and their claims are thin descriptions of responsible AB-use, and do not reflect what is happening in practice. Their paper realities make believe how the livestock industry is doing, however, they fail to grasp how AB-use is driven by milk prices, milk residues, lack of consistent milk recording across farmer landscapes, online pharmacies, AB pricing competition between veterinary practices, financial problems with farmers, the veterinary business model, and more (see Chapter 7). The gap between data and actual practice moreover questions the meaning of responsible AB-use; a reduction in sales/usage does not necessarily mean that ABs are used in responsible manner. My fieldwork highlighted a number of risky AB practices, ranging from disposal of ABs in slurries, falsification of medicine records, misuse of milk residue tests, dubious dispensing routes, lack of farmer understanding of AB withdrawal times, farmers dispensing ABs to top up courses and more. These practices fall outside the statistical realities we have come to trust and which inform the UK's future

policies. As I will discuss in the next section, the actor-networks in which ABs circulate come with different matters of concern, and consequently, different AB practices.

## 8.6 Antibiotic policies and their practices in the UK dairy sector

### 8.6.1 Different matters of concern

The dairy supply chain is expected to drive and standardise responsible AB-use across dairy farmers. The formulation, implementation and adoption of responsible AB-use within the UK dairy industry, however, is far from a linear process; instead, it is interactional and interpretative, located within and across dairy supply chain actor-networks and their concerns. This means there are limitations when we assess policies only from *within* the policy framework. Chapter 6 discussed how dairy supply chain actor networks do not act in a vacuum when responding to their AB-use responsibilities as food supply chains; there are economic opportunities attached to the evidencing of responsible AB-use activities. Although dairy supply chain actors produce the data that is expected within the UK's industry-led policy frame, such as AB sales reduction targets, they tailor dairy AB policies and practices as well to interests outside policy frames. Consequently, what matters outside policy frameworks shapes how responsible AB-use is practiced. It is the combination of the dairy supply chain performativity within and outside UK's industry-led policy framework that shapes how ABs travel in dairy cows, in their milk and enter food supply chains and the wider environments. Where policymakers want to see evidence of AB reduction, milk processors want to avoid milk residues in their milk supply chain and retailers want to differentiate themselves to consumers. Responsible AB-use in the dairy supply chain should therefore not be solely evaluated from metrological results presented in the annual VMD UK-VARSS surveillance reports.

In this thesis I have provided new methodological insights into how metrological results can be complemented by other types of knowledge that emanates from the actors themselves. By interviewing dairy supply chain actors and observing AB practices, I let dairy supply chain actors define boundaries and expectations of responsible AB-use. Moreover, I have come to understand how their actor-networks define the content and translation of responsible AB-use. What I found is that the milk supply chain response to responsible AB-use is a multi-actor decision-making process; a negotiation, in which human and non-humans determine how policies are rolled out. As discussed in Chapter 5 and 6, the milk contracts between either farmers and milk processors (non-aligned) and retailers (aligned), define the farmer production standards, including AB standards, for which a milk price is received in return. Different

interests drive the content and expectations of these standards, set out in the milk contracts and translated into milk prices. In the following section, I will describe how the actor-network of each dairy supply chain shapes policy, and the intended and unintended effects (overflows) of dairy supply chain policies in practice.

### 8.6.2 The 'overflows' of dairy supply chain-led antibiotic policies

#### **Overflows of milk processors' antibiotic policies**

What matters to milk processors is that the milk they collect and process does not contain milk residues that exceed their MRL. According to EU legislation, milk of *individual* cows cannot enter the food supply chain if it contains milk residues that exceed their MRL (FSA, 2015). When milk processors collect raw milk from farms, milk gets diluted with milk from other farms when it moves from the individual cow to the milk processor plant. The same happens with milk residues. This is referred to as the 'dilution effect', and is sometimes deliberately used by farmers to avoid milk waste. Other farmers lack awareness of how to work with milk residue withdrawal times and thus allow residues to pass in to the food supply chain. Milk processors consider farmers the biggest risk to excessive milk residues, and use the responsible AB-use debate to implement policies that increase farmers' understanding of milk residues. However, overflows of these milk processor policies can be observed.

Milk processors advocate the use of Selective Dry Cow Therapy (SDCT) in order to stimulate the transition from Dry Cow Therapy (prophylaxis) to SDCT (therapeutic). As more than 50% of dairy AB-use takes place during DCT, it is believed SDCT policies will lower AB-use and consequently, milk residue risks. Milk processors offer their farmers SDCT training and workshops, so farmers can improve their understanding of the SDCT procedure. However, discrepancies can be observed between the content of the SDCT training programmes and protocols and the situations on the farm that shape the format. Farmers argue that the training programmes fail to consider the bigger picture of the farm, while vets argue they are not included enough in the policy programmes. Moreover, vets discuss the limitations of protocols as an educational method, as farmers have their own creative ways of implementing protocols, not always corresponding to its intentions. SDCT policies fail to work as 'boundary objects' (Fox, 2011) between milk processors, farmers and veterinarians; the policies fail to incorporate the lifeworld of the farmer and veterinary profession.

To tackle the risk of milk residues in the dairy supply chain, milk processors have introduced milk price penalties to farmers when milk residues are found to exceed their MRL levels. The high penalties attached to milk residue failures, together with a new industry guideline that



forbids feeding wasted milk to calves, encourages farmers to dispose of milk into the environment. This potentially increases environmental AMR pressure, threatening farmers, other living entities on the farms, and other ecological equilibriums on or near the farm. The penalties applied by milk processors with regard to residues which exceed the MRL have stimulated farmers' use of on-farm milk residue tests to evaluate whether their produced milk is safe. Although these interventions might improve milk safety in the food supply chain, it does not mean that ABs are used more responsibly, nor AMR risks are reduced. Instead, new social and natural orders are 'co-produced', with new uncertainties around AMR.

On-farm self-testing of milk residues by farmers has other unintended consequences. Farmers become more knowledgeable about *how* to use ABs instead of re-thinking *why* they use ABs in the first place. Instead of changing on-farm practices to become less dependent upon ABs, farmers will either start using ABs that are not detected by regular tests or use the tests to limit the risk of milk residue failure. The interventions lead to reactive policies, rather than changes that reduce farmers' need for ABs.

### **Overflows of retailer's antibiotic policies**

The customer profile of each UK retailer, shapes the retailer's AB policies. Retailers with high customer profiles who expect high quality products will have aligned milk contracts with a 'farmer milk pool'. In this situation farmers receive a fixed cost-production milk price for meeting certain quality standards. This milk price mechanism, which steers farmers' practices, offers retailers the possibility of including consumer expectations in dairy production standards. To farmers in return, an aligned milk contract with a fixed milk price means economic security; for retailers there is an opportunity to market products with added value for example, high animal welfare standards. In contrast, retailers who have low customer profiles (customers interested in low priced products), will prioritise affordable products and are less inclined to engage themselves with the quality of production. These retailers will only contract milk processors with whom they have supply agreements. The customer profiles equally impact upon the AB policy strategies of retailers. Retailers with customers who expect high quality products have AB standards defined in their farmer aligned milk contracts. Retailers who do not contract farmers directly will divert responsible use strategies to the milk processors.

Retailers are seen by farmers and veterinary surgeons as potential drivers for responsible AB-use, however, Chapter 6 demonstrates how farmers implement the retailer AB standards in accordance with their own actor-networks. Farmers fear the loss of the aligned milk contract, as it provides them economic security. Consequently, farmers will ensure standards are met

on paper, but will find ways to circumvent the system. My fieldwork shows that farmers invent new pathways through which they can continue their AB-use, by for example, administering two ABs but recording only one, using multiple milk contracts, having secret medicine boxes, and using ABs from their neighbours. Hence, farmers cover their practices instead of changing them. Some farmers perceive the workshops and meetings organised by retailers as ‘tick box’ events: they tick the box to show good behaviours, but go home and continue with their day-to-day business.

Retailers with farmers in aligned milk contracts represent only 20% of the farmer population. The other 80% of the UK dairy population has non-aligned milk processor contracts. Since 2016, retailers who buy non-aligned milk from processors have been working on a voluntary basis with the farmers of these milk processors, to implement AB surveillance systems. There is however, limited oversight on how this actually takes place and takes shape in practice. The different aligned and non-aligned milk contracts with different AB standards and milk prices shape different farmer practices, and potentially, bacterial responses.

### **Overflows of Red Tractor antibiotic policies**

The Dairy Red Tractor Scheme is the UK’s private national Farm Assurance Scheme, covering 95% of UK’s dairy farmers. It is considered to be a powerful mechanism to standardise UK dairy farmers in their husbandry and AB-use. The Dairy Red Tractor Scheme (Red Tractor Assurance, 2018) builds on trust, in which it is assumed that dairy farmers perform the standards in accordance with the Scheme expectations. Importantly, the standards are produced in co-construction with farmer organisations. It is this co-construction which raises concerns about the quality of the Dairy Red Tractor Scheme. It is argued that the AB standards embedded within the Scheme are designed to benefit the farmers rather than foster innovation. Interestingly, the Dairy Red Tractor Scheme has only recently, in 2018, amended its standards. Since July 2018, the Scheme requires farmers to perform culture and sensitivity testing before using CIAs. Farmers must record their total medicine use and use of SDCT in their Herd Health Plan, which must be evaluated with their vets on an annual basis. In cases of milk residue failure, farmers and their vets are expected to follow a training course how to use ABs responsibly.

In common with how farmers respond to supply chain standards, farmers have their own interpretations of the Red Tractor Dairy standards. From my fieldwork these interpretations include falsification of records, tick boxing of husbandry standards, and sometimes stubborn responses to veterinary consultation, rather than proactive attitudes. Although the Herd Health Plan of the Dairy Red Tractor Scheme is meant to strengthen the veterinary-farmer

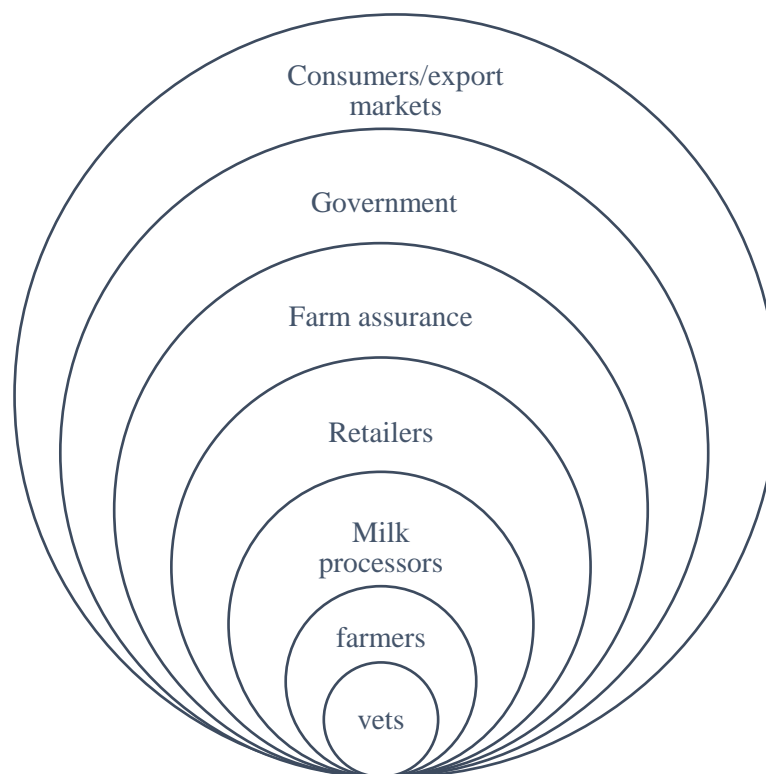
relationship, vets express little confidence in this mechanism. The veterinary-farmer relationship is still troubled by the AB power relationship, in which both professions are trapped. There are several pathways through which farmers have *access* to ABs, which gives farmers power to constrain vets in their prescribing choices. At the same time, disease informants and AB informants in the agricultural network of farmers – see Chapter 7 – continue to contribute to farmers’ perceived need for ABs. As long as these actors dominate in farmers’ agricultural networks, training programmes will have limited power to overrule these actors and drive the change they claim to make.

### 8.6.3 Antibiotic decision-making in practice:

When farmers encounter a clinical problem in their herd, the agricultural network of the farmer will shape farmers’ response to disease. Existing disease informants, AB informants, the contentious veterinary-farmer relationship and farmers’ accessibility to ABs, are actors that contribute to farmer’s AB decision-making. In many cases, a process of trial and error will take place, which includes the use of ABs, before a vet will be asked to visit the farm. First, actors such as the clinical presentation and value of the cow, the opportunity for farmers to discuss issues over the phone with vets, staff on the farm, and lay/official disease protocols, create the context within which farmers decide how to engage with the problem. Second, AB informants will steer farmers’ choice in what type of AB to choose for the particular clinical condition. Third, the accessibility of drugs on farms makes it easy for farmers to grab an AB to start AB treatment. Consequently, the recommended policies, such as AB reduction policies, AB training/education, and the veterinary-farmer relationship as mechanism to drive change, have to battle against the actors discussed above. A major tension in the proposed agricultural policy recommendations is the responsabilisation of vets to support farmers in their transition towards responsible AB-use. Vets are expected to educate their farmers, but they are still trapped in economic relationships with farmers, colleagues and competing veterinary practices. Farmers’ access to ABs constrains vets in their AB decision-making process. This limits vets to change their business model from mainly drug financed to consultancy financed, and with it, their prescribing practices. Vets will often obey the logics of farmer actor-networks to remain profitable as a business. The veterinary authority on its knowledge and objects is not evident, and is often ignored in AB policy models.

## 8.7 Case study: An ANT intervention built into the Dairy Red Tractor Scheme.

The study and management of dairy sector actor-networks can enable us to examine why the UK dairy industry fails to innovate. With 95% of UK dairy farmers contracted by the Dairy Red Tractor Scheme, it has the potential to drive change. But as previously discussed, the Dairy Red Tractor Scheme is heavily embedded in dairy supply chain agricultural networks. This constrains the performance of the Scheme. How can we achieve good animal health and welfare in practice while strengthening the economic position of farmers and veterinary practices? What is *needed* for the dairy industry to enable innovation against a fair cost-production price of milk? As discussed, practising animal health and welfare involves more than a set of standards; it involves dealing with actor-networks of consumers, policymakers, farm assurance, food supply chain actors, farmers and veterinarians, who each come with their own interests and performances. What the consumers and export markets expect travels all the way down to farmers' husbandry practices and the veterinary-farmer relationship (See Figure 8.2). These actors 'co-produce' animal health and welfare and consequently, AB practices. We therefore need to engage with every level and evaluate how they influence each other practices, instead of treating them as silo's (see Figure 8.2).



**Fig. 8.2:** Responsible dairy farming as multi-layered performance

Interventions need to focus on actor-networks from farm to fork: In order to do so, I am using the Dairy Red Tractor Scheme as a case study to demonstrate the ways in which it could be 're-assembled' using ideas drawn from ANT to develop a more robust set of responsible AB-use practices (Latour 2005). I will start with recommendations that could strengthen the UK veterinary profession and vet-farmer relation. Next I will propose interventions that can alleviate economic tensions across the UK dairy supply chain. Finally, I will argue what regulatory interventions and types of support from the UK government are needed to support the UK dairy industry as a whole. I will end this Chapter with a final conclusion of the thesis.

### 8.7.1 Strengthen the veterinary profession

The Herd Health Plan in the Dairy Red Tractor Scheme aims to stimulate the veterinary-farmer relation. It *requires* proactive, farm-specific health planning between the farmer and his vet: vets must undertake an annual review with farmers to evaluate the herd health status and AB usage in their herds. The Scheme *recommends* involvement of vets in all aspects of health planning throughout the year. Industry policymakers believe that these veterinary-farmer contacts can be pivotal in changing a farmer's husbandry and AB practices.

This thesis has evidenced that not all farmers are interested in the advice from vets. I argued this is not a 'behavioural problem' but the outcome of several networks pressures. Farmers need to juggle the responsibilities that come from actors both on and off the farm. The milk prices they receive from milk processors or retailers are tight and some farmers struggle to produce against the cost-production price of milk. Retailers and milk processors are also caught up in milk price wars; consumers expect low prices against high quality. Financial pressures lead farmers to look for quick fixes, such as AB-use, rather than changes to husbandry practices or animal housing requiring greater investment and often with uncertain outcomes. To remain in business, farmers want their dairy cows to be healthy to produce and sell as much milk as possible. But health is performed in different ways. To some farmers, this means investing in preventative disease interventions, high herd immunity status, and high housing standards. To others, health is performed by responding to problems as they occur, such as administering ABs. Living in isolated communities, farmers have often been removed from external advice and the need to change. Even though newer generations of farmers have received agricultural training and will bring in new knowledge to the farm, this will in most cases be diluted by the existing farm culture. This thesis has evidenced that farmers will often return to the lay protocols and practices they are familiar with.

Even though the dairy Red Tractor Scheme puts the Herd Health Plan forward as a tool to stimulate the engagement of both vets and farmers, as has been shown farmers have other priorities in their actor-networks to worry about. Farmers try to reduce their costs by avoiding calling out vets; vets have developed a business model based on selling drugs rather than on selling their time and expertise. This relationship has to be fundamentally changed if farmers are to be supported in becoming more responsible. Most importantly, the veterinary professions needs to be strengthened in order to achieve a healthy economic veterinary-farmer relation.

### **Contractual relations between the veterinarians and farmers**

In the Netherlands, legislation that required a 1-1 relationship between vets and farmers reduced competition between veterinary practices, by ensuring that farmers can only procure veterinary services and medicines from one veterinary practice. Each livestock vet in the Netherlands needs to be certified on top of their degree to practice as a veterinarian in the livestock industry (Geborgde dierenarts, KNMVD). In a similar vein, the Dairy Red Tractor Farm Assurance Scheme can require that 1 veterinary practice, chosen by the farmer, becomes appointed in the Scheme. This practice will be responsible to fulfil the mandatory contact hours between the farmer and the vet. As there is a large variety of quality amongst veterinary practices in the UK, there is potential risk that some farmers receive less good advice than others. To ensure veterinary practices across the UK are up to date with their knowledge, the BVA should require all UK dairy vets to follow a short course on dairy herd health, for which they receive a certificate in return. The course should cover the topics that will be discussed during the regular contact hours, such mandatory disease programmes and preventative strategies. This certificate enables vets/practices to become included in the Scheme.

### **Re-distribute husbandry expertise to veterinarians**

Due to the competitive milk market, retailers and milk processors have their own expert teams and agricultural consultants (kite, promar) who dictate and audit the husbandry standards. This undermines the local veterinary practices who are often left out of the discussion. But local vets are the first point of contact for the farmer, rather than the consultants. In addition, different types of information circulate which complicate husbandry practices. One way to reduce the different knowledge sources is to send independent supply chain consultants to local veterinary practices instead of farms. By working together with local veterinary practices, farms can be more closely monitored in accordance with supply chain expectations, while vets can invest in knowledge and their relation with farmers. The Red Tractor Scheme could

include a standard which requires a liaison between supply chains and local veterinary practices.

#### **Veterinary-farmer relation: implement regular contact moments**

The Red Tractor Scheme should require a minimal number of annual contact hours between the veterinarian and the farmer. This could be initially subsidised by either the government or by the food supply chain. Alternatively, veterinary practices could offer annual consultancy packages at an affordable price. Opening up isolated farms to up-to-date tailored advice could support the transition from responsive farming to responsible farming. Prevention strategies, such as herd immunity, disease control programmes, biosecurity, breeding techniques, housing investments and environmental standards should be regularly addressed and progress towards achieving aims regularly monitored.

#### **8.7.2 Alleviate milk supply chain tensions**

I have shown how responsible AB-use standards enter existing competitive dairy markets, tailored to the interests of supply chain members, rather than public health concerns. Different policies, different penalty-reward systems and different engagement strategies inevitably fragment AB practices, rather than levelling them out. This results in dairy farmers engaging in various irresponsible AB activities outside the numerical and paper realities relied upon by policymakers and the public. Another worrying trend is the overflows created by the strong retailer involvement in the UK dairy supply chain. Although the competitive supply chain model is meant to drive dairy husbandry innovation, we see the opposite happening. The retailer-aligned farmers (25%) receive extra support, guidance and stable milk price income, in comparison to the non-aligned milk processor farmers (75%). Aligned farmers are stimulated to innovate their farming practices, while non-aligned farmers are stimulated to invest in milk quality and safety. As a result, a large group of dairy farmers are unable to make the transition towards responsible farming. The following proposals could alleviate some of these tensions.

#### **Re-distribute responsibility for antibiotic standards**

The formulation of AB initiatives should be distributed to actors *outside* economic markets, rather than being solely left to economic actors. This does not mean economic actors are excluded from the discussion, but they should not be left in full independent control of the

interpretation, design and implementation of AB policies. Instead of trusting a competitive model to do the work, the Dairy Red Tractor Scheme could dictate the standards (in consultation with the industry, consumers and government) and improve auditing of their practices. By distributing this responsibility away from milk processors and retailers, they can invest their resources in other mechanisms, such as National Milk Recording, veterinary-farmer contact hours, and milk quality differentiation strategies.

### **Improve transparency of milk contracts and their pricing mechanisms**

The different milk contracts lack transparency in their pricing mechanisms. This leaves farmers in the dark about which milk contracts to choose and what it actually means for them when signing up for a contract. Different milk prices, either volatile or fixed, and milk contract expectations disrupt milk supply chain integration. This issue has already been raised by the National Farmers' Union (NFU) and a dairy code was designed to provide transparency and confidence in the milk contract between milk processor and milk producer. The NFU has argued for the Code to be mandatory in order for farmers to get fair milk contracts. This is, however, not currently the case, with milk contracts and their pricing mechanisms remaining confidential and preventing detailed comparisons between the contracts, besides the prices paid (Costa-Font and Revoredo-Giha 2017). This should be picked up again by agricultural authorities and dairy organisations to improve farmer equality and dairy supply chain integration.

### **Consumer campaigns to debate the low milk prices**

The retailer-consumer relation determines the retailer expectations of how dairy products are produced and the price to be paid. This results in several constraining network activities: retailers defining profit margins of milk processors, milk-processor milk prices, retailer milk prices, milk production standards, the veterinary-farmer relation and more. One strategy to create more margin on the milk price is to raise awareness with consumers. The UK is one of the few countries in Europe where a bottle of milk is cheaper than a bottle of water. Retailers could invest in responsible farming dairy campaigns to create more consumer awareness. In addition, consumer expectations and their overflows should become openly discussed. Dairy organisations could work together to engage with society, media and policymakers with the dairy supply chain and other food supply chains.



### **Subsidise milkprice**

Being part of the European Union means that farmers in European countries receive a single farmer payment subsidy to achieve the aims set out in the CAP. In the case of the UK in 2019, this will change these circumstances; although farmers are not subjected anymore to European food laws, they will lose their subsidy. An alternative to the single payment system could be for the UK government to finance a minimal milk price. This ensures that UK dairy farmers are able to produce against the cost-production price of their milk at all times. In case the milkprice drops below cost-production price, a subsidy can be provided for the time being. One of the overflows of the single farmer payment is that farmers don't necessarily invest the subsidy in innovation. The subsidies fail as such to deliver purpose. To reduce overflows from happening with milk price subsidies, the subsidy can be tied to a disease control program or to vet-farmer contact hours. This provides some oversight in how the money is translated in the farm. In case farmers fail to use the subsidies for which they are appointed to, farmers can lose their right on the subsidy.

### **Subsidise disease control programmes**

To eradicate persistent herd health issues, such as mastitis and feet problems, the Red Tractor Scheme should include disease control programmes which have economic incentive for the farmer. This has proved to be successful in Sweden in which the government subsidises these programmes (Lundström, 2016). AHDB dairy has designed a Mastitis Control Plan and Health Feet Programme to support farmers in their practices (AHDB Dairy, 2017b, 2017a). These programmes can be made mandatory in the Red Tractor Scheme, funded by the UK government and/or dairy organisations such as AHDB dairy and Dairy UK, including subsidisation of laboratory costs. Local veterinarians should be made responsible to implement these programmes with their farmers.

### **8.7.3 Official interventions / support**

All Red Tractor dairy farms are required to register their AB usage (written or digital). The dairy medicine book needs to be annually reviewed between the farmer and the veterinarian (Dairy Red Tractor 2018). Since March 2018, CIA's can only be used as a last resort and must be supported by sensitivity testing or diagnostic testing. In addition, the standards recommend at least one member of staff is responsible for administering medicines to hold a certificate of competence (Dairy Red Tractor 2018). Although the dairy medicine book appears to evidence the delivery of results on paper, this thesis demonstrates that the standards do not necessarily

translate into farmer practices. Network pressures produce overflows as farmers and veterinarians find new ways to continue their practices, with farmers dictating what ABs they want from their vets. With only 1 contact moment per year, there is little follow up in a farmer's husbandry and AB practices, farmers quickly fall back into old habits. Interventions at multiple levels, proposed in this discussion, are therefore essential to changing practice.

### **Tighter regulation around prescribing/dispensing**

As long as farmers have their own medicine cupboards, they will use them, appropriately or inappropriately. One of the policy goals should be therefore to reduce the type and volume of ABs available on farms. Veterinary practices should not be able to prescribe over the phone, or dispense ABs in their veterinary practices, without clear veterinary oversight of how ABs end up in the dairy cow. The bulk delivery of ABs from veterinary practices to farms should be restricted. Regulation around prescribing/dispensing should therefore be tightened. Considering the potential destructive consequences of decoupling veterinary prescribing from sales (e.g. animal welfare, disruptive professional consequences), I propose to review the legislation implemented in the Netherlands. The Netherlands strengthened the position of vets via legislation that tackled farmer ownership over ABs (Speksnijder et al., 2014). Through legislation (UDD-maatregel), only vets are able to start AB treatment (although exceptions are made in cases where animal welfare could be compromised) (Mevius & Heederik, 2014). Farmers can only have ABs on their farms for the course of the treatment or for a short period in time, verified by their vet.

Considering the infrastructure of the UK dairy industry at the moment, the former proposal might not yet be feasible. Nevertheless, Dairy Red Tractor could require farmers to limit the types and amount of ABs on dairy farms. This should be audited on a regular basis, with unannounced visits rather than announced. This intervention could also limit farmers' use of ABs that have gone out of date and reduce the 'waste' disposal of out of date ABs into the environment. Farmers should also not be able to administer CIAs themselves. Interventions that restrict AB-use are however vulnerable to overflows: it could lead to more off the radar practices on farms. Therefore, it is essential that this intervention is executed with other interventions that reduce the network pressure on farmers to use ABs.

### **Establish a cross-sector antibiotic surveillance institute**

When UK policymakers responded in 2016 to the O'Neill reports (2015, 2016), supply chains were made responsible for collecting AB usage data or developing national surveillance usage systems. Consequently, the supply chains spend much time and resources to achieve these

targets. In the UK dairy industry, this has resulted in a lack of progress, with still no surveillance system in place by the end of the year 2018. Moreover, collecting both on-farm usage *and* veterinary usage is considered a long-term rather than a short-term goal. The Netherlands, Sweden and Denmark all have either a government-led or private-led institute that collects on-farm and veterinary usage data for each livestock sector. This can improve oversight of what happens with ABs, from sales, to prescribing, to dispensing, to administration. With the VMD being responsible for collecting veterinary sales and sector usage data to develop the UK-VARRS reports, they could take this responsibility from the shoulders of the industries. With the expertise, knowledge and resources available, they can collect and analyse AB usage data of livestock farms, analyse veterinary prescription patterns, and define benchmarks (in cooperation with the sectors), regarding the quantity and types of ABs used within each livestock sector. The Dairy Red Tractor Scheme can subsequently use these benchmarks to inform their expectations of farmers' AB-use and veterinary prescription patterns (SDa Autoriteit Diergeneesmiddelen, 2019). As this thesis has shown, data surveillance systems present a thin description of reality.

#### **Make National Milk Recording (NMR) obligatory**

National Milk Records (NMR) is the UK's leading supplier of milk recording services. They deliver tools to manage cows' production, health and fertility and provide management information on individual cow performance in terms of milk quality, yield and fertility. As membership involves a fee, not all dairy farmers in the UK record their milk. By making national milk recording mandatory in the Dairy Red Tractor Scheme, more knowledge about the husbandry practices of farmers will become available to veterinary surgeons and auditors of the milk contracts. An important reason to make NMR mandatory is that it will support farmers to adopt SDCT. NMR provides insight in the Somatic Cell Count (SCC) history of individual cows. This delivers information on mastitis risks in individual cows and informs the SDCT protocol. Moreover, farmers can challenge themselves to improve their husbandry practices and hygiene protocols to improve milking practices. This will lower the long term need for ABs significantly during the dry cow period. To distribute the financial burden, retailers and milk processors should include this requirement in their milk contracts, for which farmers will be compensated through the milk price they receive. I will discuss in the supply chain section what support is needed for milk processors and retailers.

## **Agriculture, antibiotic practices and the environment**

Milk processors and the Dairy Red Tractor Scheme require farmers to dispose of milk contaminated by residues into slurries, rather than feeding it to calves. Although these initiatives might reduce the risk of milk residues entering the food supply chain, they create potential new environmental risks to AMR. Even though dairy supply chains/industry policymakers are aware of this trend, potential overflows of this practice are ignored. To prevent new environmental AMR hazards from happening, The UK's Animal Health Plant Agency (AHPA) should allocate resources to assessing the risks arising from overflows. Research councils could make money available to support research in this area of concern.

Responsible farming needs be aligned with environmental debates. How do we innovate our industries so they coincide with targets on climate change, sustainable energy use, landscape architecture and biodiversity? What place is there for more traditional farming systems? Should we reduce quantity but improve quality of food animal products? Is there a willingness in society to consume less animal products if this will translate itself 'responsible farming'? Answers to these questions should be openly debated with the public, in order to inform future Dairy Red Tractor Scheme standards and dairy markets.

## **8.8 Conclusion**

Using the methodology of examining the dairy AB actor-networks of the UK dairy sector, I have demonstrated how different matters of concern about dairy ABs circulate. By tracing ABs in their actor-networks, I discovered what dairy actors are of importance and to whom, and how this steers AB decision-making: how milk residues drive milk processor policies; how customer profiles drive retailer policies and how agricultural interests define Red Tractor farm assurance standards. To farmers, AB decision-making is situated in complex agricultural networks; milk prices, milk contracts, milk withdrawal times, milk residues, on-farm staff, disease interpretations, AB availability, and veterinary prescribing accessibility. All of these and more define how farmers end up using ABs. Similarly, medicine-driven veterinary business models, drug price competition between veterinary practices, peer pressure, farmer pressure, over the phone prescribing re amongst the most important factors in defining how vets prescribe ABs.

The understanding of actor-networks is crucial if we want to evaluate how industries take up their responsibility in terms of AB governance. In fact, what my work emphasises is that AB-use is an inherent dairy supply chain economic activity, instead of an individual *choice* of farmers and vets. AB decision-making in terms of policies and practices is situated in the co-

existence and overlapping of multiple markets, ranging from pharmaceutical markets, consumer markets, contractual relationships in food supply chains, animal productivity, animal welfare and veterinary business models. Importantly, these markets do not like uncertainties; they prefer instead to frame problems and reduce uncertainties to avoid market unpredictability. As Callon et al. (2009, p.236) argue, ‘markets, when calculating interest, profits, and return on investments, draw a strict dividing line between that which is taken into account and that which is not’.

With these markets strictly defining what to take into account and what to ignore in terms of responsible AB-use (to maintain maximum output in their economic actor-networks), they generate exclusions and overflows. Fragmented AB policies, tailored to the interests of dairy supply chain actors is the result. Moreover, these dairy supply chain AB policies are practiced in accordance with the economic interests of farmers and veterinary surgeons, potentially ‘co-producing’ new invisible environmental, foodborne and human routes of AMR. Consequently, by making livestock industries responsible for implementing AB policies, without taking into account what ‘matters of concern’ drive their AB decision-making, AB policies and their practices will choose unexpected directions, with unintended consequences and overflows.

The UK’s political culture is heavily influenced by the legitimacy of specialists and their scientific methods. It has become blinded by the false belief in the objectivity of science. Policy targets and instruments are implemented to purify the social factors that drive the ‘misuse and overuse’ of ABs. The proposed methods of science, such as AB surveillance, AB programmes/guidelines and education, are expected to rationalise individual AB decision-making. This culture-nature divide, however, fails to capture how AB-use is the outcome of actor-network decisions (involving both human and non-human actors). Rather it focuses on behaviours as individual decisions made by farmers or veterinary surgeons. Problematically, methods of science are unable to capture and tackle the actor-network complexities involved with AB decision-making. With the UK’s political culture trusting science, there is an implicit reliance on measuring targets and the outcomes of those targets. It ignores the complexity of livestock sectors actor-networks interpretations and practices of responsible AB-use. The UK’s trust in science, together with political and agricultural interests, paralyses these actors leaving them unable to question their own initiatives. Instead of making animal husbandry systems and their structural problems the central topic of discussion, we find that the debate recurrently focuses upon how to devise and perfect instruments that enable the measurement and management of AB-use. Consequently, dairy husbandry systems fail to innovate, resulting in the persistence of agricultural AB networks which have been described in this thesis. The UK’s technocratic industry-led framework becomes a risk to AMR in itself: its methods and

practices ‘co-produce’ a whole range of new social and natural orders, lacking oversight of the overflows these new orders generate.

Having exposed the complexity of dairy AB actor-networks and the overflows they generate, it becomes difficult to believe we can transfer antimicrobial policy responsibilities solely to the UK dairy industry. Neither can we trust farmers and veterinarians to throw their AB interests overboard if there are no financial alternatives offered. As I suggest, the problem is not AB-use in itself; the ‘misuse and overuse’ is merely a symptom of a dairy sector in need of structural change. In order to re-evaluate our policy frame and interventions, we need to engage with the complexity of dairy AB networks rather than wanting to reduce it. This involves examining ‘matters of concerns’ at multiple levels, from veterinarians, farmers, food supply chains, governments to consumers, and how they ‘co-produce’ each other. Interventions need to simultaneously address these multiple levels to reduce the risk of overflows. Moreover, we need to continuously work *with* overflows of interventions and tackle them rather than ignoring them.

One topic I left mostly unexplored in this thesis are the potential effects of the UK leaving the European Union. Being part of Europe means being part of their internal food market with food products produced against certain minimal standards. Although food standards come with overflows, leaving Europe means leaving a framework that tries to support good husbandry practice, to the consumer, the animal and the environment. Brexit means entering new competitive agricultural markets with potential disruptions to the internal market. How will animal health and welfare, consumer expectations, and export positions be translated in food safety and quality? How can the UK compete with markets which have significant lower animal health and welfare standards? How will it set import and export tariffs without disrupting national markets? How will it patrol its borders to avoid the risks of importing non-native livestock diseases? These are just a few questions which will need to be addressed if the UK leaves the EU.

To conclude, we find that policy and science offer a reductionist way of seeing the world. Dairy AB-use gets boiled down to an issue of ‘overuse and misuse’, which results in a self-fulfilling prophecy: if only we measure we can see how effective we are. Within this frame, overflows don’t matter because the frame has been set only to examine the use/misuse in relation to veterinary and farmer practices. However, in order to be effective, we have to look at the whole dairy supply chain network. The question next becomes how we can study AB-use as part of a bigger picture of animal welfare, environmental impact and sustainable food production. Further research projects should therefore address the complex economic relationships which underpin food production, explore environmental concerns, include public

views, examine the overflows of responsible AB-use policies, compare country approaches, and more. But for now, with the uncertainty of Brexit and a UK dairy sector in need for support and security, it is important to work together at the levels proposed in this thesis to drive changes in the UK dairy sector as a whole.

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## **Appendices**

## Appendix 1. Participant Information Sheets.

### **Participant Information Sheet Policymakers**

#### How is policy on antimicrobial use in agriculture shaped and implemented in England and Sweden?

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##### ***What is the purpose of this study?***

This PhD research aims to understand how different agricultural-political cultures produce policy on AB-use in agriculture and antimicrobial resistance (AMR). A comparative qualitative case study will be performed in England and Sweden, to understand how policy on AB-use in farm animals is shaped and implemented within a specific agricultural-political context. The project will explore how involved human and animal agencies in both countries are involved in the management of the issue and how they experience the process of the governance of the issue. Themes of interest are the development of policy, the process of execution in practice, and the evaluation of policy as such. This will provide knowledge on how the process of policy development on AB-use in agriculture is entangled with a countries specific agricultural-political context. Hence, the project can serve as a platform for English and Swedish policy makers.

##### ***Why have I been invited to take part?***

You have been invited to take part as you have knowledge and experience relevant to this study. If you do not wish to be involved in this study, then please let us know and we will remove your contact details from our mailing list. If you have any queries or concerns that are not covered by this information sheet please do not hesitate to get in touch (see contact details below).

##### ***What will happen if I take part?***

If you agree to take part you will be contacted via telephone or email to find out when it would be convenient to talk to you. Your interview will be carried out face-to-face with the PhD student, so a convenient date and place will be arranged. The interview will, with your permission, be audio recorded so that all the points you make can be fully captured. Interviews



are anticipated to last between 30 minutes and an hour. All information you provide will be treated in strictest confidence.

***What will happen if I do not want to take part anymore?***

Taking part in this research is entirely voluntary, and you are free to withdraw up to the point your data are included for analysis, without explanation.

***What if I am unhappy or if there is a problem?***

If you are unhappy, or if there is a problem, please feel free to let us know by contacting Dr Robert Christley by email (robc@liverpool.ac.uk) or telephone (0151 794 6170) and he will try to help. If you remain unhappy or have a complaint which you feel he cannot resolve then you should contact the Research Governance Officer on 0151 794 8290 (ethics@liverpool.ac.uk). When contacting the Research Governance Officer, please provide details of the name or description of the study (so that it can be identified), the researchers involved, and the details of the complaint you wish to make.

***Who has reviewed the study?***

To ensure that your safety, rights, wellbeing and dignity are protected the methods for this research have been looked at by an independent group of people called a Research Ethics Committee. This study has been reviewed by University of Liverpool Veterinary School Research Ethics Committee.

***Next steps***

Please take time to consider whether you want to be included in this research. The decision to participate is your own and you should feel under no pressure to do so. If you are happy to be involved please complete the accompanying consent form and return it to stephanie.begemann@liverpool.ac.uk.

Thank you very much for considering this information.

Stephanie Begemann

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## **Participant Information Sheet Industry England**

### **How is policy on antimicrobial use in agriculture shaped and implemented in England?**

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#### ***What is the purpose of this study?***

This PhD research aims to understand how policy on antimicrobial use in agriculture and antimicrobial resistance (AMR) is governed and how the governance of the issue is perceived in practice. The project is interested in the different opinions on the governance of the issue and will explore how involved human and animal agencies experience the governance and its effects as such. Themes of interest are the involvement in the process of policy development on the issue, risk perceptions on food safety and antimicrobial resistance, and initiatives taken in practice since the implementation of policy. This will provide knowledge on how the process of policy development on antimicrobial use in agriculture and its implementation is perceived by involved stakeholders and can serve as a platform for English policy makers

#### ***Why have I been invited to take part?***

You have been invited to take part as you have knowledge and experience relevant to this study. If you do not wish to be involved in this study, then please let us know and we will remove your contact details from our mailing list. If you have any queries or concerns that are not covered by this information sheet please do not hesitate to get in touch (see contact details below).

#### ***What will happen if I take part?***

If you agree to take part you will be contacted via telephone or email to find out when it would be convenient to talk to you. Your interview will be carried out face-to-face with the PhD student, so a convenient date and place will be arranged. The interview will, with your permission, be audio recorded so that all the points you make can be fully captured. Interviews are anticipated to last between 30 minutes and an hour. All information you provide will be treated in strictest confidence.

#### ***What will happen if I do not want to take part anymore?***

Taking part in this research is entirely voluntary, and you are free to withdraw up to the point your data are included for analysis, without explanation

***What if I am unhappy or if there is a problem?***

If you are unhappy, or if there is a problem, please feel free to let us know by contacting Dr Robert Christley by email (robc@liverpool.ac.uk) or telephone (0151 794 6170) and he will try to help. If you remain unhappy or have a complaint which you feel he cannot resolve then you should contact the Research Governance Officer on 0151 794 8290 (ethics@liverpool.ac.uk). When contacting the Research Governance Officer, please provide details of the name or description of the study (so that it can be identified), the researchers involved, and the details of the complaint you wish to make.

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Thank you very much for considering this information.

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## **Participant Information Sheet Farmers**

### **How is policy on antimicrobial use in agriculture shaped and implemented in England?**

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#### ***What is the purpose of this study?***

This PhD research aims to understand how policy on antimicrobial use in agriculture and antimicrobial resistance (AMR) is governed and how the governance of the issue is perceived in practice. The project is interested in the different opinions of divergent stakeholders on the governance of the issue and will explore how the industry, Veterinary surgeons and farmers experience the governance and its effects as such. Themes of interest are how risk perceptions on food safety and antimicrobial resistance are experienced on local level and how political initiatives on antimicrobial use in agriculture are perceived and translated into practice. To fully capture the translation of policy to local level practices, the researcher would like to observe invited participant in their daily practices on matters related to AB-use in farm animals. The former will provide knowledge on how the process of policy development and implementation on antimicrobial use in agriculture is perceived by local agencies and can serve as a platform for English policy makers.

#### ***Why have I been invited to take part?***

You have been invited to take part as you have knowledge and experience relevant to this study. If you do not wish to be involved in this study, then please let us know and we will remove your contact details from our mailing list. If you have any queries or concerns that are not covered by this information sheet please do not hesitate to get in touch (see contact details below).

#### ***What will happen if I take part?***

If you agree to take part in participant observation, you will be contacted via telephone or email to find out when it would be convenient to you to participate in the study. The PhD researcher would like to study your work during work hours for a week. However, if you wish to take part for a shorter amount of time, this is also possible. During the observation, the researcher is interested in your activities related to animals on the farm. The researcher will observe your work and ask you questions related to biosecurity, your relationship with the veterinary practice, contact with retailers, and personal opinions on food safety and AMR. The

information provided by you will be recorded in a notebook of the researcher. Whenever there is access to personal information, such as log on medicine use in farm animals, your consent to use this information will be asked and a description will be given for what purpose it will be used.

***What will happen if I do not want to take part anymore?***

Taking part in this research is entirely voluntary, and you are free to withdraw up to the point your data are included for analysis, without explanation.

***What if I am unhappy or if there is a problem?***

If you are unhappy, or if there is a problem, please feel free to let us know by contacting Dr Robert Christley by email (robc@liverpool.ac.uk) or telephone (0151 794 6170) and he will try to help. If you remain unhappy or have a complaint which you feel he cannot resolve then you should contact the Research Governance Officer on 0151 794 8290 (ethics@liverpool.ac.uk). When contacting the Research Governance Officer, please provide details of the name or description of the study (so that it can be identified), the researchers involved, and the details of the complaint you wish to make.

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Thank you very much for considering this information.

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## **Participant Information Sheet veterinary surgeons**

### **How is policy on antimicrobial use in agriculture shaped and implemented in England?**

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#### ***What is the purpose of this study?***

This PhD research aims to understand how policy on antimicrobial use in agriculture and antimicrobial resistance (AMR) is governed and how the governance of the issue is perceived in practice. The project is interested in the different opinions of divergent stakeholders on the governance of the issue and will explore how the industry, Veterinary surgeons and farmers experience the governance and its effects as such. Themes of interest are how risk perceptions on food safety and antimicrobial resistance are experienced on local level and how political initiatives on antimicrobial use in agriculture are perceived and translated into practice. To fully capture the translation of policy to local level practices, the researcher would like to observe invited participant in their daily practices on matters related to AB-use in farm animals. The former will provide knowledge on how the process of policy development and implementation on antimicrobial use in agriculture is perceived by local agencies and can serve as a platform for English policy makers.

#### ***Why have I been invited to take part?***

You have been invited to take part as you have knowledge and experience relevant to this study. If you do not wish to be involved in this study, then please let us know and we will remove your contact details from our mailing list. If you have any queries or concerns that are not covered by this information sheet please do not hesitate to get in touch (see contact details below).

#### ***What will happen if I take part?***

If you agree to take part in participant observation, you will be contacted via telephone or email to find out when it would be convenient to you to participate in the study. The PhD researcher would like to study your work during work hours for a week. However, if you wish to take part for a shorter amount of time, this is also possible. During the observation, the researcher is interested in your activities related to animals on the farm. The researcher will observe your work and ask you questions related to AB-use in farm animals, biosecurity, your relationship with the farmer, relations with food and pharmaceutical industry, and personal

opinions on food safety and AMR. The information provided by you will be recorded in a notebook of the researcher.

Whenever there is access to personal information, such as log on medicine use in farm animals, your consent to use this information will be asked and a description will be given for what purpose it will be used.

***What will happen if I do not want to take part anymore?***

Taking part in this research is entirely voluntary, and you are free to withdraw up to the point your data are included for analysis, without explanation

***What if I am unhappy or if there is a problem?***

If you are unhappy, or if there is a problem, please feel free to let us know by contacting Dr Robert Christley by email (robc@liverpool.ac.uk) or telephone (0151 794 6170) and he will try to help. If you remain unhappy or have a complaint which you feel he cannot resolve then you should contact the Research Governance Officer on 0151 794 8290 (ethics@liverpool.ac.uk). When contacting the Research Governance Officer, please provide details of the name or description of the study (so that it can be identified), the researchers involved, and the details of the complaint you wish to make.

***Who has reviewed the study?***

To ensure that your safety, rights, wellbeing and dignity are protected the methods for this research have been looked at by an independent group of people called a Research Ethics Committee. This study has been reviewed by University of Liverpool Veterinary School Research Ethics Committee.

***Next steps***

Please take time to consider whether you want to be included in this research. The decision to participate is your own and you should feel under no pressure to do so. If you are happy to be involved please complete the accompanying consent form and return it to stephanie.begemann@liverpool.ac.uk.

Thank you very much for considering this information.

**Stephanie Begemann NIHR HPRU PhD Student**

The University of Liverpool, Leahurst Campus, School of Veterinary Science, Neston, CH64 7TE

**Email:** stephanie.begemann@liverpool.ac.uk **Website:** www.liverpool.ac.uk/

## Appendix 2. Participant Consent Form



### Committee on Research Ethics

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#### PARTICIPANT CONSENT FORM

**Title of Research Project:** ABs, farm animals and arguments in England: How is policy shaped and what are its effects in practice?

**Researcher(s):** Stephanie Begemann, Rob Christley, Liz Perkins, Francine Watkins

**Please  
initial box**

1. I confirm that I have read and have understood the information sheet dated 08-06-2016 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.
2. I understand that my participation is voluntary and that I am free to withdraw up to the point my data are included for analysis, without explanation. In addition, should I not wish to answer any particular question or questions, I am free to decline.
3. I agree that my participation will be recorded and I am aware of and consent to your use of these recordings for the following purposes: publication in thesis and possible publication in research papers.
4. I understand that my responses will be kept strictly confidential. I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research, unless I have given permission.
5. I agree to take part in the above study.



Participant Name	Date	Signature
Researcher taking consent	Date	Signature

**Principal Investigator:**

Name: Robert Christley  
Work Address: Leahurst Campus, Neston, CH467TE  
Work Telephone: 01517946170  
Work Email: rob.@liv.ac.uk

**Student Researcher:**

Name: Stephanie Begemann  
Work Address: Leahurst Campus, Neston, CH467TE  
Work Telephone 0151 794 9542  
Work Email: stephanie.begemann@liverpool.ac.uk

## Committee on Research Ethics

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### PARTICIPANT CONSENT FORM

**Title of Research Project:** ABs, farm animals and arguments in England: How is policy shaped and what are its effects in practice?

**Researcher(s):** Stephanie Begemann, Rob Christley, Liz Perkins, Francine Watkins

- Please  
initial box**
6. I confirm that I have read and have understood the information sheet dated 08-06-2016 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.
7. I understand that my participation is voluntary and that I am free to withdraw up to the point my data are included for analysis, without explanation. In addition, should I not wish to answer any particular question or questions, I am free to decline.
8. I agree that notes will be taken during the observation and I am aware of and consent to your use of these notes for the following purposes: publication in thesis and possible publication in research papers.
9. I understand that my responses will be kept strictly confidential. I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research, unless I have given permission.
10. I agree to take part in the above study.
-

Participant Name

Date

Signature

---

Researcher taking consent

Date

Signature

**Principal Investigator:**

Name: Robert Christley  
Work Address: Leahurst Campus, Neston, CH467TE  
Work Telephone: 01517946170  
Work Email: rob.@liv.ac.uk

**Student Researcher:**

Name: Stephanie Begemann  
Work Address: Leahurst Campus, Neston, CH467TE  
Work Telephone 0151 794 9542  
Work Email: stephanie.begemann@liverpool.ac.uk

## Appendix 3. Interview guides

### Interview Guide Policymakers England

Thank you for taking the time to speak to me today. This conversation should take about an hour, but may take more or less time depending on how much you want to say. During our conversation, I may take a few notes but I will be recording the session on a digital voice recorder so I don't miss anything important. I want to reassure you all your responses will be kept confidential. This means that any information you provide will only be shared within the research team, and we will ensure information is anonymised so you cannot be identified. You don't have to talk about anything you don't want to, and if you feel uncomfortable at any point and wish to take a break or end the interview, please let me know. If you have any questions before we start, please let me know.

#### Introduction:

This interview is being conducted to get your input about the governance of AB-use in farm animals and antimicrobial resistance (AMR) in England. I am especially interested in what your thoughts and concerns are on the topic, and how you think the uncertainties on the topic should be managed.

#### Interview Guide

The opening section of the interview is intended to set the scene, initiate conversation with the participant, encourage them to feel at ease within the context and establish a rapport.

#### *Background and position of the interviewee:*

- Can you briefly describe your background?
- Can you briefly describe your responsibilities in your current position?
- How are you involved with ABs, animals, food and/or human health?
- How do you think your background influences your thoughts and opinion on the topic?

#### *Policy:*

- Can you briefly describe your involvement thus so far with policy that concerns AMR?
- Who informs the debate on political level concerning AMR?
- How were decisions made in your organization with respect to the content of AMR policy?
- How is a multidisciplinary approach addressed in your organization?
- How does your organization evaluates the effects of policy in practice?

- What do you think of the UK Antimicrobial Resistance 2013-2018 strategy programme?

*Opinion:*

- What type of concerns have you had or heard on the topic?
- How do you think involved stakeholders are taking up the implemented strategies?
- Are you aware of any problems between involved stakeholders on the topic?
- Is your organizational environment changing because of the debate?
- What should the role of science be in the debate?
- How is the government taking up its responsibility?
- Are you satisfied with the progress made on the governance of the issue?
- What do you think of the large differences in veterinary AB sales in Europe?
- Do you take any precautions yourself towards the consumption of meat?
- What are your concerns regarding imported meat?

## Interview Guide England Industry

Thank you for taking the time to speak to me today. This conversation should take about an hour, but may take more or less time depending on how much you want to say. During our conversation, I may take a few notes but I will be recording the session on a digital voice recorder so I don't miss anything important. I want to reassure you all your responses will be kept confidential. This means that any information you provide will only be shared within the research team, and we will ensure information is anonymised so you cannot be identified. You don't have to talk about anything you don't want to, and if you feel uncomfortable at any point and wish to take a break or end the interview, please let me know. If you have any questions before we start, please let me know.

Introduction:

This interview is being conducted to get your input about the governance of AB-use in farm animals and antimicrobial resistance (AMR) in England. I am especially interested in what your thoughts and concerns are on the topic, and how you think the uncertainties on the topic should be managed.

### Interview Guide

The opening section of the interview is intended to set the scene, initiate conversation with the participant, encourage them to feel at ease within the context and establish a rapport.

*Background and position of the interviewee:*

- Can you briefly describe your background?
- Can you briefly describe your responsibilities in your current position?
- How are you involved with ABs, animals, food and/or human health?
- How do you think your background influences your thoughts and opinion on the topic?

*Policy:*

- Is your sector involved thus so far with policy that concerns AMR? If yes, can you elaborate on this?
- Is your sector taking measures to limit the development of AMR? If yes, can you elaborate on this?
- What do you think of the UK Antimicrobial Resistance 2013-2018 strategy programme?

*Opinion:*

- What type of concerns have you had or heard on AB-use in farm animals and the link with AMR in human health?
- Are you aware of any problems between involved stakeholders on the topic?

- How do you think involved stakeholders are taking up the implemented strategies?
- Is your organizational environment changing because of the debate?
- What should the role of science be in the debate?
- How is the government taking up its responsibility?
- Are you satisfied with the progress made on the governance of the issue?
- What do you think of the large differences in veterinary AB sales in Europe?
- Do you take any precautions yourself towards the consumption of meat?
- What are your concerns regarding imported meat and AMR?

## **Interview Guide Farmers and Veterinary surgeons**

Thank you for taking the time to speak to me today. This conversation should take about an hour, but may take more or less time depending on how much you want to say. During our conversation, I may take a few notes but I will be recording the session on a digital voice recorder so I don't miss anything important. I want to reassure you all your responses will be kept confidential. This means that any information you provide will only be shared within the research team, and we will ensure information is anonymised so you cannot be identified. You don't have to talk about anything you don't want to, and if you feel uncomfortable at any point and wish to take a break or end the interview, please let me know. If you have any questions before we start, please let me know.

### Introduction:

This interview is being conducted to get your input about the governance of AB-use in farm animals and antimicrobial resistance (AMR) in England. I am especially interested in what your thoughts and concerns are on the topic, and how you think the uncertainties on the topic should be managed.

### **Interview Guide**

The opening section of the interview is intended to set the scene, initiate conversation with the participant, encourage them to feel at ease within the context and establish a rapport.

#### *Background and position of the interviewee:*

- Can you briefly describe your background?
- Can you briefly describe your responsibilities in your current position?
- How do you think your background influences your thoughts and opinion on the topic?

#### *Policy:*

- Are you aware of professional involvement of your sector with policy that concerns AMR? If yes, can you elaborate on this?
- Is your sector taking measures to limit the development of AMR? If yes, when did you first hear about taking measures and by whom was this delegated?
- What do you think should be the responsibility of your profession in safeguarding AMR?
- What should be the responsibility of the English government in safeguarding AMR?
- What do you think of the UK Five Year Antimicrobial Resistance Strategy Programme 2013-2018? Do you think your sector is enough involved in the Programme?
- Are you aware of any problems between involved stakeholders on the topic?



- How do you think involved stakeholders are taking up the implemented strategies?
- What should be the role of science in the debate?
- How do other European/non-European countries taking up their responsibilities?

*Effects in Practice:*

- What type of concerns have you had or heard on AB-use in farm animals and the link with AMR in human health?
- How did your work environment change because of policy measures?
- What do you think of alternatives to antimicrobial use, such as vaccines, supplements, feeding strategies and/or biosecurity measures?
- What measures do you take yourself in practice to limit AMR development?
- Do you take any precautions yourself towards the consumption of meat?
- What are your concerns regarding imported meat and AMR?

## Appendix 4: ethical approval



Veterinary Research Ethics Committee

**Committee Chairman**

**Dr David Killick**

BVetMed PhD DipECVIM-CA (onc) MRCVS

Institute of Veterinary Science  
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Dear Rob

I am pleased to inform you that the Veterinary Research Ethics Committee has approved your application for ethical approval. Details of the approval can be found below.

Ref:	VREC438
PI:	Dr R Christley
Title:	Antibiotics, farm animals and arguments in England: How is policy shaped and what are its effects in practice
Institute:	Veterinary Science
Department:	EPH
First Reviewer:	M Senior
Second Reviewer:	E Singer
Date of initial review:	16.6.16
Date of Approval:	23.8.16

**This approval applies for the duration of the research.** If it is proposed to extend the duration of the study as specified in the application form, the Veterinary Research Ethics Committee should be notified. If it is proposed to make an amendment to the research, you should notify the Veterinary Research Ethics Committee by following the Notice of Amendment procedure outlined at [http://www.liv.ac.uk/researchethics/application/forms\\_and\\_templates/](http://www.liv.ac.uk/researchethics/application/forms_and_templates/).

If the named PI/Supervisor leaves the employment of the University during the course of this approval, the approval will lapse. Therefore please contact the RGO at [ethics@liverpool.ac.uk](mailto:ethics@liverpool.ac.uk) in order to notify them of a change in PI / Supervisor.

**All serious adverse events** must be reported to the Committee within 24 hours of their occurrence, via the Research Governance Office ([ethics@liv.ac.uk](mailto:ethics@liv.ac.uk))

With best wishes

A handwritten signature in black ink, appearing to read 'DKillick'.

David Killick

Chair, Veterinary Research Ethics Committee

A member of the  
Russell Group

# How Political Cultures Produce Different Antibiotic Policies in Agriculture: A Historical Comparative Case Study between the United Kingdom and Sweden

Stephanie Begemann,\* Elizabeth Perkins,  
Ine Van Hoyweghen, Robert Christley and Francine Watkins

## Abstract

The purpose of this article is to provide an understanding of how different countries formulate and regulate antibiotic use in animals raised for human consumption. A comparative case study was undertaken, analysing historical documents from the 1950s to the 1990s from the UK, the first country to produce a scientific report on the public health risks of agricultural antibiotic use; and Sweden, the first country to produce legislation on the growth promoter use of antibiotics in food animals. Sheila Jasanoff's concepts of 'co-production' and 'political cultures' have been used to explore how both countries used different styles of scientific reasoning and justification of the risks of agricultural antibiotic use. It will be argued that national dynamics between policy, science and public knowledges co-produced different risk classifications and patterns of agricultural antibiotic use between both countries. UK's political culture used 'expert committees' to remove the issue from public debate and to inform agricultural antibiotic policies. In contrast, the Swedish 'consensus-oriented' political culture made concerns related to agricultural antibiotic use into a cooperative debate that included multiple discourses. Understanding how national policies, science and public knowledges interact with the risks related to agricultural antibiotic use can provide valuable insights in understanding and addressing countries agricultural use of antibiotics.

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## Introduction

Although antimicrobial resistance (AMR) is a universal public health concern, gaps remain in our current understanding of the magnitude of the problem in humans and animals and the impact on the environment. A major health concern is the 'inappropriate' agricultural use of antibiotics in animals raised for human consumption (O'Neill 2015). Whether or not there is a link between antibiotic use in animals and the development of AMR in humans through food and the environment is controversial (Schwarz et al. 2001; Kahn 2016). To address the uncertainty and scientific complexity of AMR, global efforts have been directed at reducing antibiotic use in both human and animal populations. Historical and recent data show large differences in antibiotic usage and its regulation between countries (EMA 2016). These differences have been explored in several studies focused on the political, economic,

technical, legal and behavioural causes that affect agricultural antibiotic use. However, all these studies adopt the stance of 'what is wrong and what needs to be fixed' (Dar et al. 2015; Meek et al. 2015; O'Neill 2015). By taking this stance, they reduce farm antibiotic use to a singular cause and solution, thereby failing to identify the relational component of these differences (Buller et al. 2015, Wallinga et al. 2015). Chandler et al. (2016) have used the concept of 'antimicrobial infrastructures' to describe the importance of historical trajectories of antimicrobials to consider how they have been used and regulated, as a way of understanding current practices. Kahn (2016) also examined the politics of AMR and agricultural antibiotic use in the UK, Sweden, Denmark, Europe and the US using an historical lens. Although Kahn (2016) describes at length the different scientific discourses and regulatory approaches, she does not examine how the earliest international scientific evidence, the 'UK Swann report' – the first report on the hazards of antibiotic use in food animals – resulted in different policy approaches to agricultural antibiotics between countries.

This article explores the politics of antibiotic use in food animals and its possible link with AMR in humans. It uses an historical comparative analysis between the UK, the first country that produced international advice to restrict economic antibiotic growth promoters (AGPs) in animals produced for human consumption; and Sweden, the first country that officially banned the use of AGPs in animals produced for human consumption. It will also explore how these two countries produced different risk classifications and policies on agricultural antibiotic use. In direct contradiction to traditional risk policy studies which adopt the perspective that science is value free (Stirling 2010), it is argued that the UK and Sweden use scientific reasoning in different ways to assess the risks of agricultural antibiotic use. Theoretical reasoning from Science and Technology Studies (STS) will be used to demonstrate that science and its technologies are culturally influenced and a product of the context they are embedded in (Bijker et al. 1987; Jasanoff 2004; Sismondo 2011). STS is useful in this context because of the way it examines how science is produced, legitimated and integrated in the policies and products of societies (Metzler and Webster 2011; Ulucanlar et al. 2013). Resisting the rational production of scientific knowledge, Jasanoff (2004, p. 3) uses the concept of 'co-production', to show how science and its technologies both produce and are produced by 'social practices, norms, conventions, discourse, instruments and institutions'. Consequently, the risks of biotechnologies are also co-produced and are framed by the contexts in which they are developed and used. To emphasise the entanglement of science, national politics and public knowledges, Jasanoff (2005, p. 21) has introduced 'political cultures', which she uses to explore how countries have specific ways of using science in political decision making about biotechnological risks. This, at the same time, steers knowledge and innovation of the biotechnology under discussion. In her comparative study between the UK, Germany and the U.S. on issues such as embryo research, genetically modified food, stem cell debate and other products of biotechnology, Jasanoff shows how different risk constructions and innovation policies emerged over time between the three countries, due to 'different ideologies, priorities and ways of national reasoning' between policy, science, and public knowledges (2005, p. 275). Moreover, scientific claims and their use do not possess the power of 'truth' in themselves; they are part of historically established ways of national risk framing, institutional arrangements, public input and culturally specific ways of legitimating science in society (Jasanoff 2005). At the same time, Jasanoff argues that 'the public' is not a passive, homogeneous recipient of knowledge but instead, engages actively in the production and application of science and technologies (Jasanoff 2005, p. 255).

She refers instead to an assemblage of 'publics', emphasising the plurality of publics or public knowledges (2005, p. 255). Jasanoff is also interested in how publics have culturally specific 'tacit knowledge-ways' through which they assess scientific claims (2005, p. 255). As other STS scholars have argued, publics are capable of acting within political systems and reinventing them, as well as being created and co-produced by them (Callon et al. 2001; Marres 2007; Asdal 2008). This is in contrast to models focusing on the 'public understanding of science', which see science as universal and attribute differences in social uptake of science as a consequence of public misunderstanding or ignorance and these differences can be overcome by better informing the public (Jasanoff 2005, p. 249). Instead, Jasanoff (2005) advocates we should explore how political cultures have specific ways of making science accountable to citizens and how these citizens in turn have culturally embedded ways through which they collectively acquire and apply knowledge about science and its technologies. Importantly, 'social contracts' can be in play between science and politics to 'steer' scientific findings into political goals and to set boundaries on biotechnological risks (Jasanoff 2005, p. 226). This has also been argued by Stirling (2010), who suggests that we should explore presented risks beyond the 'single definitions presented by science that are most amenable to political manipulation' (p. 4). The way political cultures use science during the rationalisation of emerging biotechnological risks is formulated by Jasanoff (2004) as the stabilisation of biotechnologies. This concept of stabilisation will be used to study how farm antibiotics became legitimised/stabilised and problematised/destabilised over time through political cultures. Political cultures as such 'co-produce' the knowledge and innovations of biotechnologies.

Following Jasanoff (2005), the period in the UK between the 1950s–1990s can be characterised as a political culture governed by 'expert committees' (p. 102). The government maintained (and still does) a strong relation with science and scientific 'expert committees' in the governance of risks. These expert committees are presented as providing independent and impartial advice to the government on the basis of evidence and means that they enjoy a widely respected status of 'character, experience and expertise' through which they gained public credibility (Jasanoff 1997, p. 228). The UK government uses these expert committees to settle scientific controversies and to act on behalf of the public under the imperative of public safety. Sweden on the other hand is not only characterised by State interventionism, but also by a 'consensus-oriented' political culture, bridging State and private actors (Bostrom and Klintman 2006, p. 165). Scientific controversies are managed outside the traditional science-policy arena. Instead of identifiable scientific experts being used as the (only) powerful actors to formulate and steer risk policies, as in the UK's expert committees, the Swedish agricultural decision-making process involved wider public participation (Saifi 2004). This produces a more open approach towards the governance of the risks related to agricultural antibiotic use.

The political cultures of both countries will be used as a framework to study how, between the 1950s–1990s, they co-produced the stabilisation, destabilisation and re-stabilisation of agricultural antibiotic use. The article starts by exploring the agricultural contexts of both countries and how antibiotics as both therapeutics and economic tools emerged in relation to the modernisation of agriculture. With the goal of maximising food production, agriculture and its modern techniques were used as a means to improve both countries' economic position in return for cheap and abundant food. As such, agricultural antibiotics in both countries became legitimised in a 'productivist' framework. When scientific controversies

about the public health risks of economic agricultural antibiotics unsettled their use in the 1960s, the UK Swann expert committee was established in 1969. However, they presented inconclusive results on the public health risks of antibiotics used in food animals. This allowed the UK's political culture to downplay the public health risks thus enabling their continued use until the end of the 1990s. By contrast, Sweden's consensus-oriented political culture led several scientific and non-scientific discourses to enter the debate, which led to a different risk management of agricultural antibiotics. The discussion explores what can be learned from understanding the impact of a country's political culture on risk policies and the implications of this for future policy on agricultural antibiotic use.

The methodology comprises of a comparative case study using a desk-based discourse analysis of primary and secondary sources between 1950–1990 based on the following search terms: 'The Swann Report', 'farm antibiotics', 'antibiotic resistance', 'intensive farming', 'factory farms', 'animal welfare' and 'environmentalism'. Primary sources included European, UK and Swedish policy documents, UK newspaper articles of 'The Daily Mail' and 'The Times' and the UK veterinary journal 'Veterinary Record'. Secondary sources included scientific journals and books that discussed one or more of the former search terms. Following the methodology of a discourse analysis, attention was paid to what was said by whom in order to capture the coproducing effects of discourses and identities. This allowed an examination of how farm antibiotics in both countries became institutionalised through the interplay between scientific knowledges, expert committees, politics and public knowledges.

### **Setting the scene: post-war productivist agriculture and the stabilisation of agricultural antibiotics**

At the beginning of the twentieth century around 10 per cent of the British population were employed in the agricultural sector, agriculture in the UK was of little economic and public interest (Self and Storing 1963). By contrast, Swedish society was characterised as 'agrarian', with two thirds of the Swedish population working in small family farms responsible for supplying the needs of local communities (Morell 2011). Agricultural values were largely absent in the UK, while in Sweden there was a strong identification with nature (Self and Storing 1963; Morell 2011). This differences in terms of the value of agriculture, influenced the way in which agricultural antibiotic use became problematised. After the Second World War, Europe experienced the benefits of industrialisation which enabled agricultural economies to flourish. After years of food shortage, political targets were set to maximise agricultural output for economic purposes and to guarantee an era of food security (Grant 2005). The UK saw agriculture as a mechanism by which the national economy could be restored and its international trade position strengthened (Self and Storing 1963; Murdoch and Ward 1997; Grant 2005). The Swedish government wanted to make its agricultural sector more 'rational' and 'efficient', to transform its mostly rural society into a modern society (Flygare and Isacson 2011; Martiin 2015). The responsible agricultural government departments, the Ministry of Agriculture, Fisheries and Food (MAFF) in the UK and the Ministry of Agriculture in Sweden, became heavily involved with regulating agriculture during the 1950s–1970s (Murdoch and Ward 1997; Saifi and Drake 2008). To guarantee the stability of agricultural markets and agricultural prices, both countries set up agricultural price setting schemes that involved annual negotiations between State representatives and farmers to fix prices of agricultural products (Cox et al. 1986; Martiin 2015). In the UK, Post-war agricultural policies were developed between the government and

agricultural stakeholders (Wales et al. 2006). Consumers in the UK were excluded from political decisionmaking by the government who believed that if they could guarantee the consumer food safety, 'the consumer would unproblematically consume' (Wales et al. 2006, p. 190). In Sweden, however, consumers were involved in the price setting schemes of agricultural products, and this was an important part of Sweden's post-war agricultural politics (Martiiin 2015), which were built on transparency and negotiation with its consumers (Vail et al. 1994). Nevertheless, in both countries, productivist attitudes towards modern agriculture prevailed between the 1950s–1970s. Farms, farmers and their representatives all became part of the economic construction of the agricultural sector, as the agricultural community became convinced that efficient and maximum food production could only be ensured when farming was industrialised (Murdoch and Ward 1997; Saifi and Drake 2008).

The modernisation of agriculture not only produced new relations between the government, the agricultural industry and consumers, but increased market opportunities for various scientific technologies that improved animal husbandry systems, including agricultural antibiotics. Agricultural antibiotics were introduced therapeutically in both countries by the end of the 1940s to treat sick food animals (Randall 1969). By the beginning of the 1950s, it was discovered in the United States that when antibiotics were fed in low doses to food animals, these animals showed improved growth, food conversion ratio, and reproductive performance; so-called Antibiotic Growth Promoters (AGPs) (Soulsby 2007). The Post-war modern agricultural landscape, and its close relation with science as a means to industrialise agricultural husbandry, allowed agricultural antibiotics to be used as both a therapeutic (including preventative use) and an economic tool in the use of animals in food production. In the decade that followed, antibiotic use in food animals took on new purposes, quickly establishing them as standard, not only for the treatment of disease, but to prevent disease and as Antibiotic Growth Promoters (AGPs) (Randall 1969). The use of antibiotics as growth promoters acquired special attention as they could be used as 'economic tools'. In addition, as AGPs they did not require a veterinary prescription (Barton 2000). Importantly, there was no European legislation at that time and each member State approved its own regulations about AGP use (Castanon 2007).

Strong relations developed between agricultural ministries and farmer unions with a strong interest in managing the agricultural market-place together. However, while the UK excluded public debates from political discussions, Sweden made agricultural issues part of wider societal debates. Importantly, in Sweden, the high value placed on nature, combined with concerns about the impact of agricultural techniques on the environment raised environmental concerns in Swedish political debates (Vail et al. 1994). Moreover, the public participation model in Sweden allowed these concerns to infiltrate scientific risk debates on modern agriculture practices (Vail et al. 1994). The differences in governmental models and the co-production of consumers regarding the governance of agricultural policies therefore greatly influenced how both countries received the first scientific report on agricultural antibiotic use, and how the issue was problematised.

### **Controversies in the 1960s: political cultures and the destabilisation of agricultural antibiotics**

*The UK: antibiotic scientific controversies and the role of 'expert committees'*

In the 1960s, after agricultural antibiotics were constructed as economic and therapeutic tools, the first scientific evidence on resistant bacteria in food animals was reported (Randall 1969). At the same time, animal welfare concerns from consumers started to raise questions about modern agriculture (Stuart 1964). The UK's political culture of establishing expert committees to settle discussions played an important role in how agricultural antibiotic use was to become framed and regulated. In the UK, the problematisation of intensive farming practices and 'animal welfare' at the beginning of the 1960s can be seen as one of the first 'expert' discourses in which antibiotic use was considered and 'co-produced' by science and the UK government. A key event in the UK at this time was the publication of animal welfare activist Ruth Harrison's book 'Animal Machines' in 1964, in which she described the moral and ethical dimensions of intensive poultry and livestock farming. Intensive livestock farms became framed as 'factory farms', referring to the automated practices and detrimental livestock conditions. The book initiated extensive public debate and led to mass demonstrations in London that condemned the 'cruel' modern farming methods (Winter 1964). However, the agricultural industry and farmer communities responded stating that Harrison presented an unfair picture of farming to the public (Stuart 1964). The National Farmer Union condemned the book as a 'false picture of British agriculture', and the Poultry and Egg Producers' Association described its comments on intensive egg and poultry production as a 'slur on production' (Winter 1964). In the media, the response to Harrison's condemnation of intensive farming practices was dismissed as 'emotional reasoning' (Food for the table – food for thought 1964). However, in 1965, in response to the public outcry on Harrison's book, the government had to intervene to settle the controversies and to restore public trust in agricultural practices. They appointed an expert committee chaired by Professor Roger Brambell, who produced the 'Report of the Technical Committee to Enquire into the Welfare of Animals Kept Under Intensive Livestock Husbandry Systems', which became known as 'The Brambell Report' (Brambell Report 1965). Importantly, the UK's political culture had a tendency to use scientific expert committees to explore matters 'technically'. These expert committees enjoyed a widely respected status of 'character, experience and expertise' through which they gained public credibility (Jasanoff 1997, p. 228). The Brambell report concluded, surprisingly, that in the absence of scientific evidence to measure animal welfare, the ethical dimensions of animal's feelings should be taken into account when making decisions on agricultural intensive systems (Woods 2012). However, the Brambell report (1965) also encouraged the 'progressive state' of intensive agricultural systems and claimed that in relation to housing standards and the continuation of antibiotic use in livestock: 'the effects are more likely to be beneficial than adverse' (p. 14). Although tensions between scientific and ethical perspectives on animal welfare still remain unresolved (Woods 2012), the Brambell report supported the continuation of intensive livestock practices and within this the use of antibiotics. At the same time, international scientists were reporting bacteria with drug resistance in both humans and animals and in the UK, questions were raised as to whether this could be related to the practice of antibiotic feeding in farm animals. The matter was examined by a joint expert committee under the chairmanship of Lord Netherthorpe in 1960 (Randall 1969) and their report concluded in 1962 that the situation should be further explored, but reasserted there was no human health risk. The economic benefits of AGPs were re-emphasised and the committee advised continued feeding of AGPs to food animals (Randall 1969). As such, the 'expert' committees, used by the UK government to settle public controversies, were in fact co-producing the continued legitimisation of agricultural antibiotic use.



In the years that followed, new scientific counterclaims on the relationship between drug resistance, food safety and AGP use were made by veterinarians (Anderson and Path 1968; Smith 1968). Moreover, veterinary scientists Anderson and Path (1968) believed that intensive animal husbandry systems and practices provided opportunities for resistant bacteria to develop and spread, and they questioned the economic purpose of farm antibiotics. Public anxiety was also starting to rise about the effects of chemicals on health, such as DDT, insecticides and on 'things that may find their way into our food' (The Times Agricultural Respondent 1969). As a result, the economic purpose of farm antibiotics continued to be questioned or 'destabilised' by competing scientific, political and public discourses. In response to these growing concerns another expert committee was established to address these scientific and public concerns – the Swann committee – who published their recommendations in the Swann Report in 1969. The remit of the committee was to discuss the control of AGPs (antibiotics distributed without veterinary prescription to serve economic purposes) and the control of therapeutic antibiotics (antibiotics needing veterinary prescription and which served medicinal purposes) (Randall 1969). An area of particular interest for the Swann Committee was to identify AGPs which would be of economic benefit to the U.K., but would not impact on the efficacy of therapeutic drugs for humans by developing AMR (Swann Report 1969). The Swann report (1969) concluded that agricultural antibiotic use in general could pose a hazard to human and animal health as it could stimulate the development of resistant bacterial strains. However, it also recognised the economic importance of AGPs use. It advised antibiotic used in animals should not to be used as growth promoters and suggested further exploration and monitoring of the issue by setting up yet another independent scientific committee (which would not happen until the late 1990s). Swann (1969) recommended that agricultural antibiotics should be divided into two risk categories: 'feed' antibiotics (AGPs) that would be available without prescription and 'therapeutic' antibiotics that would only be available by veterinary prescription. The preventative use of antibiotics was considered less important. The shift in framing AGPs as 'feed' antibiotics can be seen as a tactical move; it downgraded the risk of AGPs into a 'harmless' food additive. The risk classification was supported by the veterinary community in UK who believed it was the higher dosages of therapeutics that led to AMR and not the sub therapeutic dosages of AGPs (Kahn 2016). In effect, the Swann report approved continuation of economic agricultural antibiotic use and 'co-produced' the use of farm antibiotics. The UK consumer was used to matters that concerned public safety being handed over to scientific expert committees who would inform the UK government (Jasanoff 1997; Wales et al. 2006). Although several UK consumer organisations existed at that time, they were not unified and did not therefore act as a co-operative pressure-group in support of consumers interests (Tivey 1968). The absence of a strong consumer movement limited the opportunity for consumers to participate in food policies (Tivey 1968). This is despite, the Chairman of the public group the 'Farm and Food Society' stating that: 'there is now a mounting pile of evidence to show that "factory farming methods", which over the last decade have made rapid advance with the full support of successive Governments and of the N.F.U., hold health hazards for the consumer'.<sup>1</sup>

The UK government represented the interests of the consumers through the advice of expert committees, which kept issues related to food risks as a private dispute between policy actors and scientists (Lowe et al. 2003; Jasanoff 2005; Wales et al. 2006). Against this political culture of science-centred approaches towards food risks and lack of public

engagement, the risk classification of agricultural antibiotics into feed and therapeutic antibiotics became established and the risks were diverted from the public radar.

*Sweden: democratic formulation of the risks of agricultural antibiotic use*

Sweden's strong environmental values and its political culture of consensus-oriented regulation of environmental and public health risks co-produced a different 'space' for the debate about agricultural antibiotics. During the 1960s–1970s, Sweden's agricultural landscape underwent massive change (Saifi 2004). As with the UK, the Swedish agricultural model was characterised by State interventionism to modernise agriculture (Flygare and Isacson 2011). Although the Swedish public held the Swedish State ultimately responsible for a clean environment and a healthy society, environmental and agricultural policies were developed through democratic debate between science, State and consumers (Vail et al. 1994; Bostrom and Klintman 2006). When Rachel Carlson's book *Silent Spring* was published in 1962 in Sweden, it led to public discussions about the environmental effects of modern agricultural practices (Flygare and Isacson 2011). Public concerns were raised about chemical use and toxic substances entering the environment that could lead to adverse effects (Vail et al. 1994). Swedish animal production had a long tradition of controlling infectious diseases in livestock (Wierup 2001), but veterinarians were concerned that antibiotics were increasingly being used to cover up poor animal husbandry practices (Kahn 2016). This prompted veterinarians to question the dependency of Swedish agriculture on industrial techniques. After the publication of the Swann report, Swedish veterinarians were one of the first groups to raise concerns about AGPs. Swedish farmers, who were dependent on the internal market, worried about the loss of trust by consumers in their products and also started to question the use of AGPs (Kahn 2016). When scientific evidence was published raising questions about the growth-promoting effects of AGPs on calves in the early 1970s, it led the calf and beef production industry to voluntarily end the use of AGP (Wierup 2001). In a public letter, the Swedish Farmer Association (LRF) promised the restrictive and careful use of antibiotics (Edqvist and Pedersen 2002). Moreover, the LRF itself requested that the Swedish government ban the use of AGPs in food animals. The Swedish Board of Agriculture reassessed the case but drew similar conclusions to the recommendations in the Swann report and advised the continued use of AGPs (Edqvist and Pedersen 2002). No consensus was reached between science, State, farmers and consumers on how to regulate AGPs and the controversies in Sweden on AGP use in food animals continued (Edqvist and Pedersen 2002). To maintain the trust of consumers and to limit the development of resistant bacteria, farmers themselves proposed that antibiotics should only be used under veterinary control (Edqvist and Pedersen 2002). In 1981, a series of newspaper articles in *Dagens Nyheter* (Daily News) reported that more than 30 tons of antibiotics were used in feed animals for growth promotion each year (Cogliani et al. 2011). Swedish consumers were outraged and a consumer report in Sweden in 1984 showed that consumer faith in meat had dropped significantly, which prompted farmers to produce food without the use of drugs (Cogliani et al. 2011). As scientific uncertainty continued, both consumer organisations and the LRF asked for mandatory policy measures to control the use of antibiotics (SOU 1997). The Swedish consensus-oriented political culture took both scientific and public knowledges seriously resulting in the 1986 Feeding Stuff Act, which banned the use of AGPs in agriculture (SOU 1997). Despite this, concerns about the regulation of preventative and therapeutic use of agricultural antibiotics in Sweden continued to grow and this further impacted on the risk classification and use of agricultural antibiotics (Grave et al. 2006).

The Swann report in Sweden raised more concerns than it answered. While it resulted in further research, this reached similar conclusions to the Swann committee. As science in the political culture of Sweden fulfilled a democratic role instead of a determining role, the debate remained open and as such, the risks of economic and therapeutic use of agricultural antibiotics were constructed as a 'visible' societal issue. This was in contrast to the UK's exclusive reliance on expert committees to inform and frame the risks about agricultural antibiotic use. The Swedish 1986 Feeding Stuff Act, which banned AGP use in agriculture, made Sweden the first country to build an economically viable agricultural system without using antibiotics to compensate for poor management and low housing standards (Wierup 2001).

### **1970's–1990's: political cultures and the re-stabilisation of agricultural antibiotics**

#### *The United Kingdom: the classification of agricultural antibiotics as economic and therapeutic tools*

Following the publication of the Swann report in the UK, an article in the Financial Times responded with the message that 'the case against antibiotic feeding has not been fully proved by any means. It could be said to be as much instinctive as factual' (Cherrington 1969). The scientific uncertainties of the report became a focus of protests from farmers and the pharmaceutical industry in 1970 who feared the consequences of limited antibiotic use in food animals (Fishlock 1970; Reeves 1970). Farmers feared additional costs would be accrued were the recommendations to be implemented and protested that small providers would be forced out of business (Williams-Smith 1970). Although many politicians supported the report, a House of Commons (1969) meeting discussed the danger of economic losses due to feed additive stocks, effects upon husbandry systems and the extra costs of food production. This only became more intensified by the growing influence of Europe. When the UK joined the EEC and the Common Agricultural Policy (CAP) in 1975, it had to engage with Europe's agricultural focus on maximum food production and food security, which further incentivised the intensification of animal husbandry systems (Grant 2005). Europe followed Swann's recommendations of dividing farm antibiotics into two categories: feed antibiotics and therapeutic antibiotics (Castanon 2007). British policy makers did not set up an independent committee to explore the AGP issue further and when Margaret Thatcher came into power 1979, her deregulatory agricultural ambitions and disinterest in farming led to a dilution of the Swann Report's recommendations (Edqvist and Pedersen 2002). In the decades that followed, several scientists (Levy et al. 1976; Linton 1977; Threlfall et al. 1978; Dutta and Devries 1984) reported evidence of the transfer of multidrug resistant bacteria between human and animals. However, in the absence of sufficient scientific evidence that the agricultural AGPs in use could pose a danger to animals, humans or the environment, they were allowed to be used (Castanon 2007). The potential risks of therapeutic antibiotics used in food animals, raised in the Swann report, became largely ignored up until the 1990s (Barton 2000). What becomes clear is that the political cultures of Europe and the UK treated the absence of conclusive evidence produced by expert committees on the link between the agricultural use of AGPs and AMR in humans as the absence of immediate risk. The media and consumers lost interest which kept further scientific scrutiny at a distance and enabled parts of the Swann's report to become aligned with governmental economic interest and the productivist mentality of the agricultural lobby. The perceived absence of human health risks associated with AGPs resulted in a re-stabilisation of antibiotics in Europe and the UK turning

them into economic and therapeutic tools. The debate was effectively silenced until the mid-1990s (Edqvist and Pedersen 2002).

During the 1980s–1990s, environmental and agricultural sustainability discourses began to emerge that created more public awareness of food safety and food quality in Europe (Grant 2012). The Bovine spongiform encephalopathy (BSE) crisis in the UK during the 1980s–1990s proved to be a critical event as the UK consumer lost trust in experts and blamed UK authorities for withholding information on the risks (Jasanoff 2005). A public debate developed which demanded that agricultural decision-making should become more accessible ‘beyond the farming unions and agricultural officials’ (Lowe et al. 2003, p. 24). The UK political culture started to experience a shift in the 1990s towards a style of governance that included consumer discussions and political transparency about the risks posed by science and its technologies (Jasanoff 2005; Irwin 2006; Wales et al. 2006). New scientific evidence of resistant bacteria in food during the late 1990s forced UK politicians into a review of agricultural antibiotics favouring public knowledges over the agricultural lobby (Department of Health 1998). The economic properties of AGPs that had made them so popular became a weapon used against them. AGPs were misused and overused because of their economic properties. Scientific committees, both in Europe and the UK, were set up by the end of the 1990s to evaluate antibiotic use and AMR both in humans and animals (Barton 2000). As a result, Europe and the UK started to phase out AGP use, leading to a complete ban of AGPs 8 years later in 2006, and implemented further destabilisation of agricultural antibiotic use in the decade that followed (Soulsby 2007).

*Sweden: the re-classification of agricultural antibiotics: therapeutic use only*

Pushed by a strong environmental lobby, Swedish policymakers developed new goals during the 1980s to limit the environmental impact of mainstream agriculture, to stimulate local food production and to support organic farming (Flygare and Isacson 2011). Concerns were not restricted to politicians, farmers and consumers anymore, but were echoed as well by public discourses on animal welfare during the 1980s (Vail et al. 1994). Moreover, the Swedish writer Ann Lindgren, well known for the creation of ‘Pippi Longstocking’, published a series of satirical stories on farm animals in leading newspapers, fuelling the animal welfare debate in Sweden (Lohr 1988). A new Animal Welfare Act was passed in 1988 which was aimed at preventing animal diseases through high production standards on farms: Sweden was the first country in the world in which farm animals received rights (Ministry of Agriculture, Food and Fisheries Sweden 1998). As earlier discussed, the UK government framed the animal welfare debate as a technical debate, which led to some technical modifications to improve housing systems but animal husbandry systems continued to be intensified (Woods 2012). The animal welfare debate in Sweden however was not silenced or dominated by science; it became a topic that involved a wide range of both technical and ethical discussions that questioned animal husbandry systems and their production techniques (SOU 1997). In contrast to the UK, animal welfare established itself as an important pillar in agricultural debates and pushed farmers and veterinarians to adjust their practices in favour of animal welfare (Federation of Swedish Farmers LRF 2015).

After the ban of AGPs in 1986, agricultural antibiotics became classified as therapeutic veterinary medicines only and had to be dispensed through pharmacies, supplied by drug wholesalers or manufacturers (Wierup 2001). Veterinarians were not permitted to own a

pharmacy or sell medicines for profit (Wierup 2001). The ban of AGP use, concerns about AMR, therapeutic agricultural antibiotic use prescribed by veterinarians only, the new focus by the public on agricultural sustainability and the flaws of animal husbandry systems resulted in Swedish farmers searching for alternatives. For farmers to produce both economically and ecologically responsible products without the use of antibiotics, investments in animal environment and management became essential (Ministry of Agriculture, Food and Fisheries 1998). In the years that followed, actions were not only taken to limit the public health risks from feed antibiotics, but also to abolish prophylactic use and limit therapeutic uses of farm antibiotics. In addition, the Swedish National Veterinary Institute (NVI) started to collect scientific facts and statistics on antimicrobial use in farm animals during the 1980's and undertook 'problem-orientated' research to limit further antibiotic use (Ministry of Agriculture, Food and Fisheries Sweden 1998; Cogliani et al. 2011). The Swedish approach to controlling infectious diseases in livestock led to the incorporation of preventive methods such as improved biosecurity, improved housing, more use of vaccines and vector control, better diagnostics including testing for sensitivity to antimicrobials (Wierup 2001). These measures, together with more effective use of antibiotics, lowered agricultural antibiotic use significantly in the years that followed. Swedish consensus-oriented policy culture framed the risks of agricultural antibiotics differently within a wider debate on the future intensive animal husbandry systems. As Sweden's political culture was characterised by consensus through a clear separation of interests, it did not solely rely on scientists to inform their decision-making process (Asdal and Gradmann 2014). The scientific uncertainty on the risks of AGPs and antibiotic use in general forced Sweden to explore the topic further and eventually ban AGPs and restrict antibiotic use to avoid potential public health risks. Societal pressure on different fronts, such as consumer pressure, farmer concerns, animal welfare, sustainability discourses, contributed to the scientific governance of agricultural antibiotic use (Edqvist and Pedersen 2002).

## **Discussion**

Reflecting upon UK's 'expert' oriented political culture, science has played an ambiguous role in the trajectory of farm antibiotics. Although scientists initially questioned the legitimacy of using farm antibiotics as AGPs, the immediate risks of both AGPs and therapeutic antibiotics were downplayed by expert scientific committees (Brambell, Netherthorpe and Swann) and the UK government, resulting in the continuation of their use. Within this political system in which consumers accepted the privileging of science over beliefs, advice from expert committees on farm antibiotics became constructed as 'matters of fact' instead of sites of controversy (Latour 1987). Hence, the UK government, experts and consumers did not act in isolation; they coproduced the 'silent' UK consumer. This enabled continuation of both economic and therapeutic use of agricultural antibiotics up until the late 1990s, when national food crises constructed a new type of consumer and institutional reform. In contrast, Sweden's consensus-oriented political culture engaged with consumer concerns, and reshaped the debate (SOU 1997; Ministry of Agriculture, Food and Fisheries Sweden 1998). Scientific evidence was negotiated before risk policies were established. Absence of conclusive scientific evidence was seen in Sweden as a possibility of risk and the use of agricultural antibiotics for economic purposes in food animals became a serious issue. This pushed the Swedish Ministry to reclassify their use and resulted in the frame of therapeutic use only (SOU 1997).

Inevitably, the different historical risk framing and regulation of agricultural antibiotics has co-produced different agricultural antibiotic trajectories in recent years. In the last decade in the UK, renewed national and international attention to resistant bacteria in food animals, green discourses and consumer debates have destabilised agricultural antibiotic use. In the wake of several food scares during the 1990s, the UK government was forced by public opinion to reform its institutional structure; core values of 'transparency and openness' became entrenched in UK food policies (Irwin 2006, p. 301). To validate the neutrality of science, public engagement became a standard part of UK policy making (Wales et al. 2006). As such, the UK government institutionalised consumers as a legitimate actor to participate in food policies. Although consumers are now represented in a consumer committee within the new Food Safety Authority, their formal powers remain limited (Wales et al. 2006). Moreover, UK's 'expert' policy culture still appears to dominate as publics are only able to enter into already formulated frames of governance (Irwin 2006). In contrast, Sweden had active consumers negotiating about the future of agricultural antibiotic use (SOU 1997). The UK government, responded to renewed national and international pressure on both human and agricultural antibiotic use by setting up a new scientific 'expert committee'. Framed by the moral overtones of antimicrobial 'overuse and misuse', 'The Review on Antimicrobial Resistance' under Chairmanship of economist Lord Jim O'Neill was set up in July 2014 by past UK Prime Minister David Cameron, to restore public trust in UK's governance of human and agricultural antibiotic use (Morris et al. 2016). In line with the overuse and misuse frame, this expert committee has formulated targets for the UK agricultural industry to reduce overall use in the agricultural sector from 62 mg/kg in 2016 to 50mg/kg by 2018 (Department of Health 2016). Through this target setting, the UK government will be able to provide 'evidence' that usage has been lowered over time which legitimates its policies to the public. However, the problems and structural needs of the agricultural industry, such as farmer productivist mentalities, problems of agricultural housing and infrastructures and the financial problems arising from the small margins under the UKs agricultural industry (RUMA 2016) remain largely unchallenged. In the past, price-setting schemes secured farmers income and empowered their position, but they are now struggling to survive as part of the UK's neoliberal food market (Farndale 2016). This market is dominated by British supermarkets who keep the food prices artificially low by fighting over market share (Farndale 2016). As such, by maintaining the narrow frame of 'antibiotic overuse and misuse', the UK government indirectly showed its disinterest in the agricultural sector by not engaging with concerns from other publics to explore how the UK agricultural industry could be pushed toward to a healthy sustainable industry. Jasanoff (2005, p. 245) calls the former the 'stickiness of frames', in that the frame through which governments approach issues/risks can lead to political inaction and inability to deal with the issue at stake. The Swedish example has shown that the will to reduce antibiotic use depends on a variety of factors (Ministry of Agriculture, Food and Fisheries 1998). The Swedish political culture proved to be reflective and pragmatic in its risk management of agricultural antibiotic use. A consensus-oriented debate between scientific knowledges and non-scientific knowledges on agricultural antibiotic use and intensive farming enabled a broader scope of what was at stake and what needed to be done (SOU 1997; Cogliani et al. 2011; Magnusson 2016). At the same time, State interventionism was accepted as the boundaries of agricultural antibiotic legislation were collectively decided upon. This pushed the agricultural industry to restrict their therapeutic antibiotic use and to adopt new innovative techniques (Wierup 2001). Today, in line with the Swedish political culture, antibiotic strategies, antimicrobial guidelines, biosecurity, disease-control programmes, and optimised management and husbandry are

continuously negotiated between the different parties (EMA 2016). The Swedish government set up mandatory evaluation of farm building plans, and developed mandatory and voluntary disease control programmes which have economic incentives for the farmer. The latest European Medicine Agency Report (2016) on antibiotic sales for food-producing animals in 2013 showed that the population-corrected (PCU) sales in tonnes of active ingredient was 422 tonnes in the United Kingdom compared to 10 tonnes in Sweden. Differences in epidemiological profiles between countries of bacteria and AMR in humans and animals have been identified as well the in latest public health reports of both the UK and Sweden (ESPAUR 2015; SWEDRES-SVARM 2015). According to a Swedish antibiotic expert: 'Sweden is 30 years ahead of many other countries when it comes to reducing its antibiotics' (Grecko in LRF 2015, p. 2).

Although the concept of political cultures provides valuable insights into how political cultures produce different risk and regulatory frames on agricultural antibiotics, there are some limitations as well. When Jasanoff (2005) used the concept of political cultures to understand why biotechnological developments were received differently in three countries, the UK and Europe had just recovered from food scares, which both challenged and produced new relations between politics, science and consumers. Today however, the interplay between markets and consumers is becoming more important when exploring how political cultures construct collective knowledge on food issues and how this interplay acts upon existing science-policy frameworks. The dynamics between science, markets and consumers has been theorised by Buller and Roe (2014) by using Caliskan and Callons' concept of 'economization' and 'marketization'. They showed how the animal welfare expectations of consumers have become assembled through 'technics, practices and materialities' into the body of the animals (Buller and Roe 2014, p. 142). In the governance of agricultural antibiotics, food supply chains increasingly dominate the science, techniques and standards that define 'responsible' antibiotic use in the bodies of animals and therefore products from our food animals (Davies 2017). Hence, the impact of markets should not be underestimated when exploring how political cultures produce collective knowledge on science and its technologies. However, the concepts political cultures and co-production provide only a limited understanding of how the sciencepolicy frames at a macro level filter into micro practices and local knowledges. Gray and Gibson (2013) have argued that farmer identities and practices are mainly shaped by the micro industrial agricultural networks they are part of, and advocate for more understanding of how these local networks influence local farmer decision-making. In a similar vein, Enticott (2012) has explored how veterinary expertise is enacted through 'localized negotiations' and 'pre-existing material relations' of the social worlds they are part of (Enticott 2012; p. 79). Tironi et al. (2013) have used Jasanoff's concept of 'civic epistemologies' or public knowledges to explore how Chilean farmers make sense of Genetically Modified (GM) technologies. They critically discuss how the concept limits itself to 'collective ways of knowing' about scientific technologies and it fails as such to grasp why Chilean farmers on a subnational level deploy multiple, often contesting frames upon the 'nature, function and effects of GM technologies' (2013, p. 102). To avoid the use of 'fixed' epistemic frames of civic epistemologies, the authors introduce the concept of 'hybrid epistemologies' to embrace the fluidity of knowledge production as such (Tironi et al. 2013, p. 102). Hence, although the concept of public knowledges has proven to be useful to understand cross-national differences in the uptake of new technologies, limitations occur when differences are observed between public knowledges of science within the same country. Hence, if we want agricultural actors to adopt new antibiotic frames, a full

assessment of their antibiotic rationalities is essential. Although the combined use of political cultures and co-production offer predictive theoretical power to explore how countries use science to govern agricultural antibiotic use, complementary research is needed to understand how networks of antibiotics are actually ‘performed’ in the settings in which they are used.

## Conclusion

This article has explored how the dynamics between policy, science and publics produced different styles of scientific reasoning and justifications of agricultural antibiotic use. It has argued that political cultures matter when trying to understand how farm antibiotics are regulated in different countries. Moreover, agricultural antibiotics and their infrastructures are heavily entwined with a country’s political culture. Although it is not denied that economic incentives influence agricultural antibiotic use, it is argued one should explore how economic incentives push political cultures in their agricultural decision-making regarding farm antibiotics. The entanglement of scientific knowledge, expertise, political models and public knowledges have been (and still are) co-producing the framing of agricultural antibiotic use, their actual use and the effects of their use. Binding antibiotic use solely into the moral public health framework of ‘overuse and misuse’ limits what might be possible, leaving the ‘responsible’ use of antibiotics only partially achievable. Leaving a country’s agricultural political context and its science-policy nexus unexplored, risks missing the national drivers that influence the construction of farm antibiotics resulting in policy initiatives that fail (or succeed) to deliver on their goals. Exploring the controversies which surround antibiotic use on a national and international level offers the possibility of identifying new ways to change behaviour and allow for multiple viewpoints to be included in decision-making processes.

## Notes

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<sup>1</sup> Better Farming or Self-Betterment? Factory “Farming” Under Attack, published in *The Veterinary Record*, Volume 86, page 110, author unknown.

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