Abstract

The work in this thesis falls into three parts. The first part relates to the time spent with the industry as part of this CASE Studentship, whilst the second and third parts relate to stochastic transmission models and the analysis of interventions imposed upon these models. The second and third parts are linked by a common aim, which is to develop models to understand the dynamics of *Salmonella* transmission on a pig farm and thus identify key drivers of *Salmonella*.

The thesis begins with an assessment and analysis of a Farm Tool Questionnaire that was developed by the industry. A total of 28 farms were visited, had pooled faecal samples taken and completed the Farm Tool Questionnaire. The main aim of this study was to pilot the developed tool and identify any areas that could be modified in order to enhance its usability. Furthermore, the results from the study were used in an attempt to highlight any possible areas of farm management that differ between Platinum farms and non-Platinum farms. It was shown that Platinum farms were likely to adopt a subset of biosecurity practices, which should consequently encourage farms to adopt a range of biosecurity practices rather than focusing on one aspect of biosecurity.

The thesis then turns to the development of mathematical models in order to try and understand how the components of the system interact by using both numerical simulation and mathematical analysis. As farming methods differ considerably between farms, two key forms of unit structure were analysed: a fully slatted unit and a solid floored unit. The models were developed using a semi-stochastic transmission model similar to Xiao et al. [2006] (Y. Xiao, D. Clancy, N. P. French & R. G. Bowers. A semi-stochastic model for *Salmonella* infection in a multi-group herd. *Mathematical Biosciences*, 200(2):214-233, 2006). These were then used to assess any differences in dynamics as a result of farm structure. Finally, both sets of models were analysed in order to identify any possible interventions that could have some form of control on *Salmonella* prevalence at slaughter.

The models showed that the key drivers of *Salmonella* transmission were the amount of bacteria shed and the probability of infection after exposure. As such, interventions focusing on these aspects should be implemented in order to see the most beneficial results. The rate at which infection was able to spread when shedding was high was found to be

of great importance within the various models; indicating that solid flooring is a potential risk factor. Furthermore, as infection was able to spread quickly within the solid-floored unit, the time interval at which cleaning and disinfection were carried out could be of importance. However, this would require further investigation.