A quantitative analysis of attitudes and behaviours concerning sustainable parasite control practices from Scottish sheep farmers

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ABSTRACT

Nematode control in sheep, by strategic use of anthelmintics, is threatened by the emergence of round-worms populations that are resistant to one or more of the currently available drugs. In response to growing concerns of Anthelmintic Resistance (AR) development in UK sheep flocks, the Sustainable Control of Parasites in Sheep (SCOPS) initiative was set up in 2003 in order to promote practical guidelines for producers and advisors. To facilitate the uptake of 'best practice' approaches to nematode management, a comprehensive understanding of the various factors influencing sheep farmers' adoption of the SCOPS principles is required.

A telephone survey of 400 Scottish sheep farmers was conducted to elicit attitudes regarding round-worm control, AR and 'best practice' recommendations. A quantitative statistical analysis approach using structural equation modelling was chosen to test the relationships between both observed and latent variables relating to general roundworm control beliefs. A model framework was developed to test the influence of socio-psychological factors on the uptake of sustainable (SCOPS) and known unsustain-able (AR selective) roundworm control practices. The analysis identified eleven factors with significant influences on the adoption of SCOPS recommended practices and AR selective practices. Two models established a good fit with the observed data with each model explaining 54% and 47% of the variance in SCOPS and AR selective behaviours, respectively. The key influences toward the adoption of best practice parasite management, as well as demonstrating negative influences on employing AR selective prac-tices were farmer's base line understanding about roundworm control and confirmation about lack of anthelmintic efficacy in a flock. The findings suggest that improving farmers' acceptance and uptake of diagnostic testing and improving underlying knowledge and awareness about nematode control may influence adoption of best practice behaviour.

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1. Introduction

The sustainable control of gastro-intestinal nematode parasites remains one of the main perennial endemic disease pressures that livestock farmers face globally (Jackson and Coop, 2000; Nieuwhof and Bishop, 2005). Gastro-intestinal nematodes impact on the health, welfare and production efficiency of livestock (Coop and Kyriazakis, 2001). For over 50 years parasite control strategies have heavily relied on suppressing nematode populations with frequent use of highly efficacious, broad spectrum anthelmintics

(Bartley, 2008). The effectiveness of these treatments is threat-ened by the emergence of nematode populations that are resistant to one or more of the anthelmintic drugs available. In the UK alone, studies have reported resistance to all three of the com-mercially available broad-spectrum anthelmintic drug classes i.e. benzimadazoles (1-BZ), levamisole (2-LV) and macrocyclic lactones (3-ML). Widespread 1-BZ resistance has been reported throughout the UK (Cawthorne and Whitehead, 1983; Sutherland et al., 1988; Grimshaw et al., 1994; Bartley et al., 2003; Mitchell et al., 2010; Thomas et al., 2015), with a much lower number of 2-LV resis-tance reports observed (Hong et al., 1994; Coles and Simkins, 1996; Mitchell et al., 2010) and increasing reports of 3-ML resistance asso-ciated with multiple drug resistance to two or more anthelmintic drug classes (Bartley et al., 2004; Sargison et al., 2005; Sargison
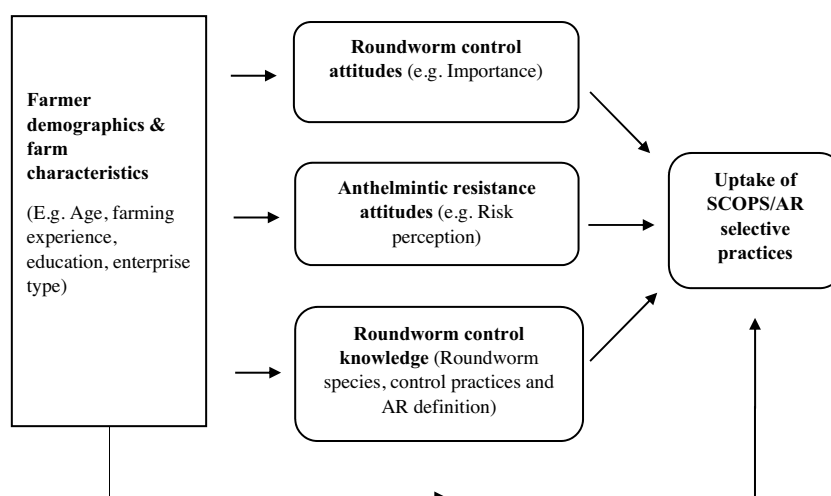
Fig. 1. Theoretical framework for general uptake of SCOPS recommended and AR selective roundworm control practices.

et al., 2007; Thomas et al., 2015). It is therefore increasingly apparent that taking steps toward maintaining sustainable productivity in the growing face of anthelmintic resistance (AR) is required by farmers.

In response to growing concerns of AR development in the UK sheep industry, the Sustainable Control of Parasites in Sheep (SCOPS) initiative was set up in 2003. SCOPS is an industry led group that represents the interests of the UK sheep industry with a remit to develop and promote practical recommendations for producers and advisors regarding 'best practice' approaches to parasite control (Abbott et al., 2012). Currently these recommendations are summarised into eight guidelines each of which outline a variety of measures to preserve the effectiveness of current and future anthelmintics. These eight guidelines broadly cover the following aspects of best practice roundworm control including: 1) Working out a control strategy with a veterinary advisor 2) implementing an effective quarantine strategy 3) testing for anthelmintic resistance, 4) administering anthelmintics effectively 5) using anthelmintics only when necessary 6) selecting the appropriate anthelmintics 7) preserving a susceptible worm population and 8) introducing alternative, non-chemotherapeutic roundworm control strategies (Abbott et al., 2012). There are numerous channels for the dissemination of the SCOPS recommendations such as through animal health advisors (e.g. veterinarians, suitably qualified persons and researchers), online/printed publications as well as face-to-face promotion at agricultural events. In other sheep producing countries such as Australia, the current equivalent repository for information and recommended practices regarding roundworm control *WormBoss* (Anonymous, 2016a,b) has achieved a high level of awareness amongst farmers. This is in part due to the effective use of the internet platform including the use of an electronic support system. However steps to measure and enhance the transition from awareness to adoption are an uncertainty recognised by both extension schemes (Woodgate and Love, 2012; Anonymous, 2013).

Various questionnaire surveys have been undertaken and published on the parasite management practices of sheep farmers from around the world, as well as within the UK (Coles, 1997; Bartley et al., 2004; Suter et al., 2005; Hughes et al., 2007; Lawrence et al., 2007; Sargison et al., 2007; Morgan et al., 2012; McMahon et al., 2013). Such studies have highlighted the variable adoption of sustainable roundworm control practices, and emphasised the need to improve promotion and perception of these practices if sustainable parasite control is to be generally accepted. In recent years the rapidly growing application of socio-psychological research

methods in behavioural science has highlighted their influence on animal health decision making. These studies have investigated behaviours relating to a wide range of disease management practices related to many livestock species as described by Wauters and Rojo-Gimeno (2014). However, a limited amount of work has investigated how socio-psychological factors may influence farmer's parasite control behaviours (e.g. Relf et al., 2012; Vande Velde et al., 2015). Moreover few studies have employed the use of quantitative modelling techniques to assess the extent at which such factors influence farmers' parasite control behaviours. The measure of human behaviour in these studies has either been indicated via behavioural intentions (e.g. Toma et al., 2015; Vande Velde et al., 2015) or by respondents' self-reported behaviours (Toma et al., 2013). The use of behavioural intention i.e. a readiness to perform a given behaviour has been proposed to be a direct proxy for actual behaviour based on the widely applied theory of planned behaviour model (Ajzen, 1991). Self-reported behaviour on the other hand requires respondents to personally state their actions regarding a specific circumstance. More recent applications of decision-making models have moved from primarily economic driven factors to also incorporate non-economic influences such as farm characteristics, farmer demographics and psychological factors. This helps to represent the range of both financial and non-financial factors involved and their potential influences in the decision making process (Edwards-Jones, 2006).

This study aims to use a quantitative statistical modelling approach to investigate the influence of socio-psychological factors on the overall adoption of SCOPS practices and practices recognised to be selective for the development of AR (designated AR selective practices hereafter). By employing such methods this will help to evaluate potential mitigation strategies to assist the adoption of best practice parasite management approaches.

2. Material and methods

2.1. Model framework

Attitudinal questionnaire items were initially devised based on a range of different source material. Questions came from a combination of common themes highlighted from farmer focus group meetings (unpublished data), as well as the research groups own parasite management experience and comparable questionnaire literature related to disease management (Bartley et al., 2003; Palmer et al., 2009; Toma et al., 2013; Alarcon et al., 2014; Vande Velde et al., 2015). The emphasis for developing questions was to