Extending Complex Agricultural Research in Australia:

The case of integrated parasite management in sheep

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I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree of qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

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Signature

Acknowledgements and Dedication

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DEDICATION

This thesis is dedicated to my baby boy Marcus, who I never got to hold. "*Never in my arms, but forever in my heart.*" The achievements of the now and the future will always pale in comparison to the gifts you gave me in life and death.

Abstract

In many agricultural industries around the world, the use of chemicals for pest or parasite control has resulted in the resistance of many of these organisms to chemicals. This has rendered many agricultural chemicals less effective or completely ineffective, leading to interest in more holistic management approaches such as integrated pest management (IPM). An IPM approach comprises biological, chemical, genetic and cultural components.

Research into resistance of livestock parasites has increased over the past two decades, however very few IPM programs, in the Australian livestock industry at least, have been developed to successfully manage parasitic resistance to chemicals. Parasites cost the Australian sheep industry nearly AUD369 million per annum. Further, pressure is mounting from overseas markets, and the public, for 'clean and green' animal products with low levels of chemical residues. With resistance to chemicals only increasing, the industry has reached a critical phase regarding how it manages the chemical issue.

The Integrated Parasite Management in sheep Project (IPM-s) was commissioned by Australian Wool Innovations Ltd to develop regional plans for integrated parasite management for the sheep industry. The project is multi-disciplinary, and comprises programs related to critical research in parasite ecology, and a socio-economic component to identify key benchmark indicators of parasite management, as well as to investigate potential impediments to the adoption of IPM practices. This thesis forms part of the socio-economic component of the IPM-s Project.

There were four research questions identified for this study related to agricultural extension, decision-making and adoption.

- Are logical choice models of decision-making useful representations of the decision-making process that producers can apply in a practical manner?

- How can research into the adoption & extension of agricultural innovations benefit from a qualitative understanding of the psychological and socio-cultural aspects of decision-making,?

- Are personal construct theory and the repertory grid technique a useful methodology for investigating the psychological and socio-cultural aspects of agricultural adoption and extension?

- What factors might impact upon the adoption of integrated parasite management for the control of worms in sheep, and what might be the variation in these factors across the population of sheep producers in south east Australia? This includes understanding the differences between researchers and producers in beliefs as to what knowledge and skills are required for competent management of parasites in sheep.

In order to meet the goals of the IPM-s project and investigate these research questions, four methods were employed, including a nationwide benchmark survey, a Delphi process with IPM-s researchers, and focus groups and personal interviews with sheep producers.

Personal Construct Theory and the repertory grid technique were found to be valuable for examining producer perceptions of IPM-s practices. This methodology allowed the identification of several key factors believed to influence producer decision-making. Specifically, there exist several over-arching socio-cultural factors that influence decision-making for worm parasite management. These factors include uncertainty, self-identity, and management control and comfort.

Further, sources and types of knowledge were indicated to be of importance, particularly as this related to the abovementioned factors. Producers and researchers were found to hold strong beliefs about particular types of knowledge, with producers indicating procedural knowledge to be very important, and researchers conceptual knowledge. These differences have the potential to affect extension of the project due to trust and communication issues.

Several practices required for the implementation of an IPM-s program were identified as potentially problematic for extension, including FEC testing, supplementary feed (specifically for worm management), selecting EBV-tested rams, weighing and monitoring body condition scores, and keeping written paddock histories. Related to these problematic practices, were findings indicating that there may exist several worm management style groups based on practices used, including a Best Practice Group, a Mixed Methods group, a Drench Reliant group and a Test Averse group. These findings indicate that there exists the possibility, at least in relation to worm management, to identify indicators of worm management styles, and potentially more comprehensive management style descriptions. The two main indicators of these worm management approaches were FEC-testing and drench resistance testing.

Finally, this research indicates that less formal, prescriptive models of decision-making could better represent the producer decision-making process. It is recommended that substantial thought be given to developing extension programs that contextualize IPM practices appropriately and meaningfully for the different parasite management style groups, and to accommodate producers' knowledge beliefs and the informal ways in which they assess information and make decisions. It is recommended that the IPM-s program could benefit from a partnerships approach to on-farm research, and the development of a trusted intermediary program in order to facilitate appropriate and effective research.

Table of Contents

List of Figures

List of Tables

List of Acronyms

BACK	Backline
BUY	Buy sheep in
C1	Conceptual knowledge level 1
C2	Conceptual knowledge level 2
CLEANPAD	Cleaning paddocks
CLININF	Clinical information (re. aneamia)
COND	Assessing Sheep Condition
CP	Refers to cleaning paddocks, including Smart grazing, cell grazing, rotation grazing, alternating sheep classes, alternating sheep with cattle and alternating sheep with crops or stubble
CRU	Crutching
CULL	Culling
D	Disposition knowledge type
DD	Darling Downs
DIP	Dipping
DRCHRES	More advanced knowledge of drench resistance - principles of "refugia" & risks of low refugia, when this is likely to occur
DRENPLN	Following an approved drench plan
DRENFEC	Drenching based on FEC results
DRENEXP	Drenching based on experience and visual assessment
DRENOPP	Drench based on opportunity
DRENROT	Rotating drenches to maintain efficacy
DRENRES2	Doing drench resistance tests every 2-3 years
DRENRE10	Doing drench resistance tests every 10 years
DRENENO	No drench resistance testing
DRPLAN	Drench Plan
DRT	Drench Resistance Testing
DS	DS are any actions or knowledge to do with a drenching strategy
EBV	Selecting EBV tested rams to manage worms (EBV - estimated breeding value)
ESI	Expected slaughter interval
FARMHIST	Farm History
FEC	Feacal Egg Counts (FEC testing)
FECREG	Doing FEC tests regularly
FECNOWAG	Doing FEC tests every now and then
FENCE	Fencing
FLUKE	Fluke
FLYT	Fly traps
FOOT	Foot health

GB	Granite Belt
GEN	Breeding & Genetics
GFM	Refers to good farm management in general
HUSB	Animal Husbandry
INFONETW	Information networks
	Ability to interpret information sources on parasite control, Use of WormBoss to aid worm treatment decision-making,
INTIFO	Able/willing to seek and evaluate expert advice
IPM	Integrated Parasite Management
IPM-s	Integrated parasite management in sheep
IWM	Integrated weed management
JET	Jetting
KSP	Knowledge, skill or practice
MARK	Marking
MOB	Mob size
MON	Refers to monitoring activities and includes components of monitoring programs or strategies, such as FEC and DRT
MULES	Mulesing
NE	New England region of NSW
NSW	New South Wales
NUT	Nutrition, including supplementary feeding
OH & S	Occupational Health and Safety
P1	Procedural knowledge level 1
P2	Procedural knowledge level 2
P3	Procedural knowledge level 3
PADHIST	Keeping written paddock histories to help manage worms
PM	Pasture or grass management
QLD/Vic	Queensland
QUA	QUA involves a quarantine strategy
SETTARG	Using set targets for ewes and weaners to monitor weights and condition scores
S SA	Southern South Australia
SHEAR	Shearing
SHPANAEM	Sheep Anaemia
SHPSUSC	Understanding of the susceptibility of sheep (most susceptible and when during lifecycle) to worms
SQld	Southern Queensland
SUPPFEED	Supplementary feeding to manage worms
SW	South West
VET	Advice & products from Vets
VIC/Vic	Victoria
WA	Western Australia
WEANMGT	Principles of weaner management - time of weaning, preparation of weaning paddocks, target weights, monitoring weight & FEC of weaners
WORMEPI	A basic understanding of the worm life cycle/epidemiology