Tech for Worms in Small Ruminants

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TE WHARE WĀNAKA O AORAKI

Moredun

ECSRHM| 23Jan2025

Precision Livestock Farming (PLF)

Farming using equipment, data or software which allows the use of information at an individual level for targeting decisions, inputs and treatments more precisely (Morgan-Davies et al, 2015).

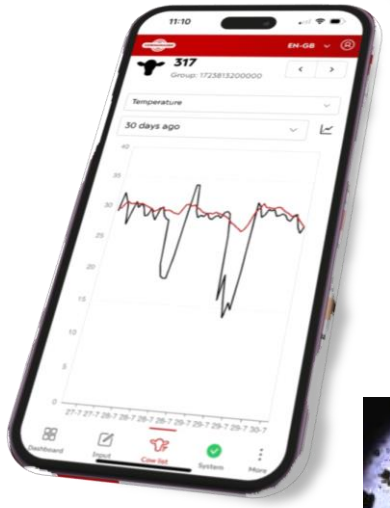
PLF tools could:

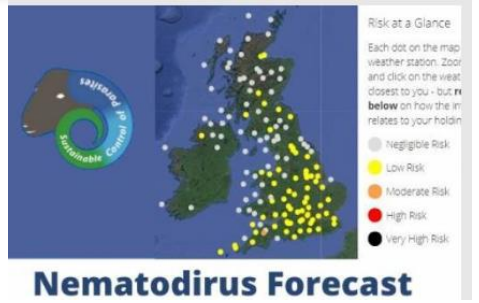
Allow decisions to be made at an individual level

Example: pregnancy scanning has transformed sheep production systems

Alerts/early warning systems

Monitor production, welfare, health

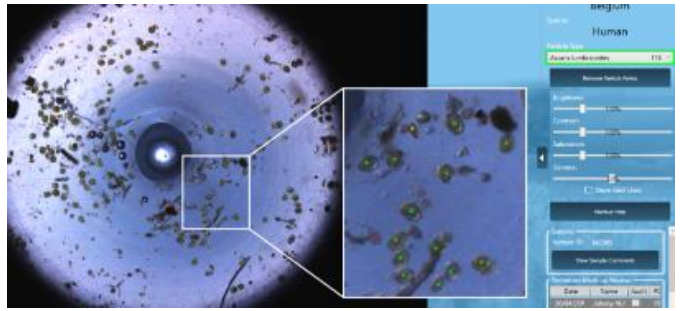




Improve efficiency

Improve ease of data recording and decision making

Example: Electronic ID tags



Sheep farming presents challenges compared to other livestock systems

- Extensive/remote
- Meat sheep handled infrequently
- Harsh(er) environment
- Welfare
- Managed at batch level
- Lower level of income
- Lack of labour
- Lower productivity
- More traditional/aging sector

Two recent projects

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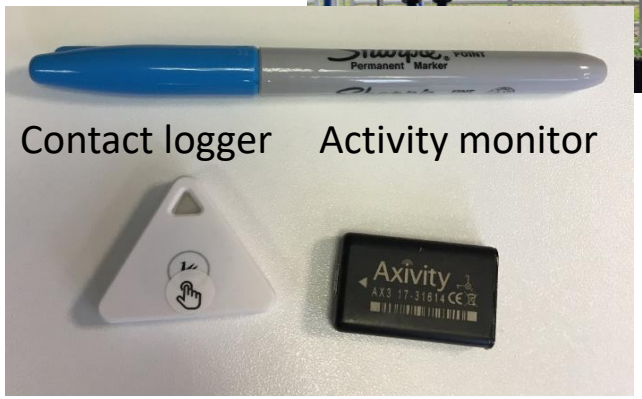
Sm@RT
Sm@ll Ruminant Technologies

What are small ruminant farmers needs/wants from technology?

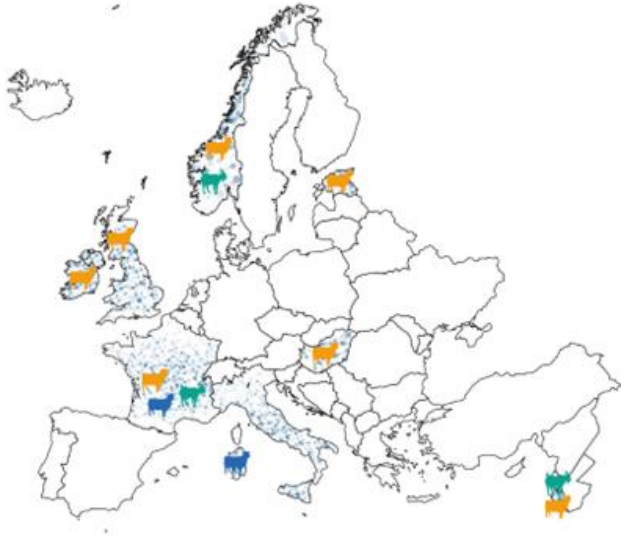
TECH CARE
Integrating innovative TECHnologies along the value Chain to improve small ruminant welfARE management

Can technology improve animal welfare and health?



Sm@RT: Small Ruminant technologies – PLF & Digital technologies

Survey conducted 2021, over 660 respondents from UK, France, Italy, Ireland, Hungary, Norway, Estonia, Spain, Israel



Respondents were asked to:

- Select the **technologies they have** on their farm
- Select which **technologies they would like** to use on their farm
- Rank the **5 technologies they deemed most beneficial** to their system

Meat sheep

Dairy sheep

Dairy goats

Sm@ll Ruminant Technologies

Sm@RT current uptake of tech by European farmers

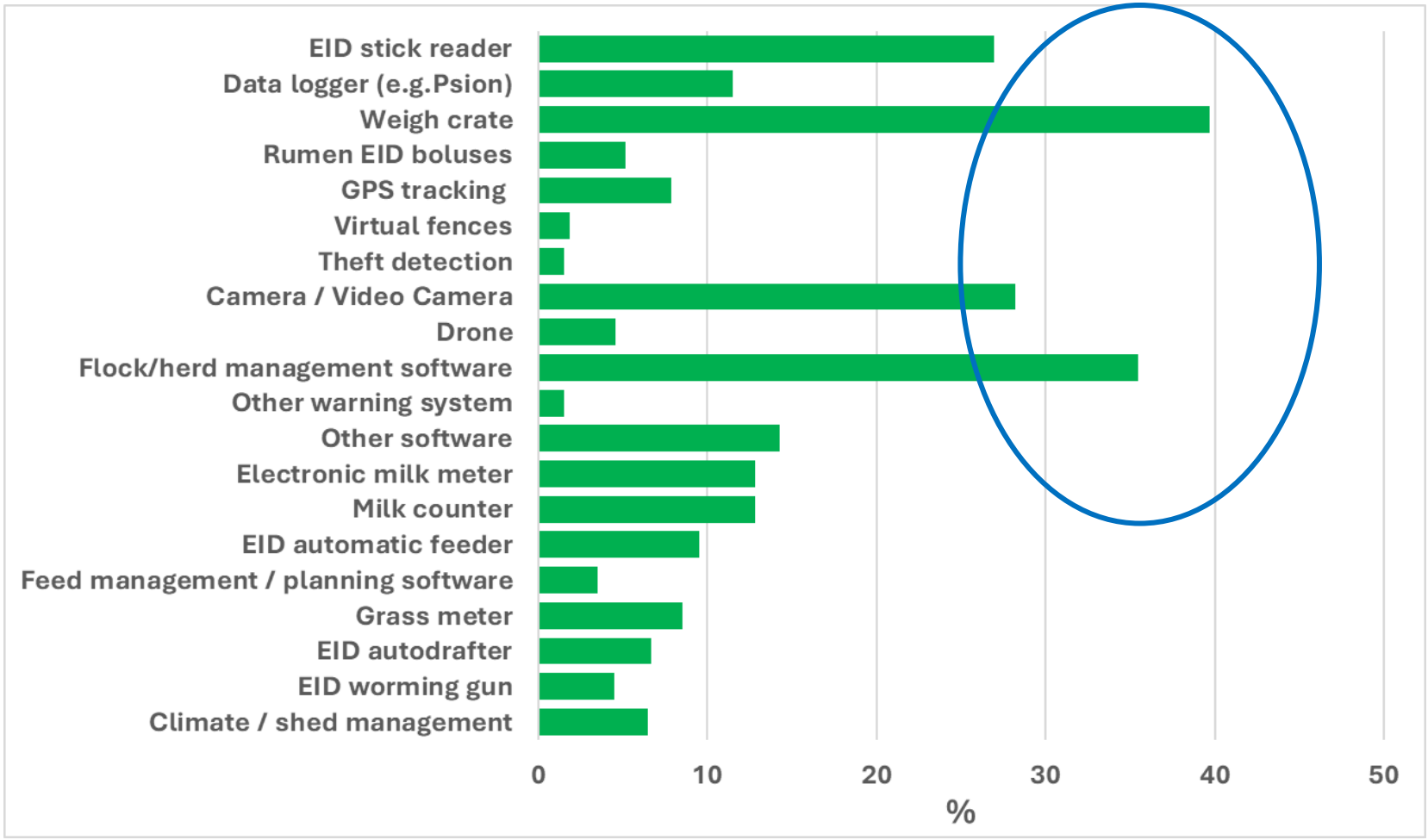
only 15 % of farmers have technologies on their farms

79% of them would like to use technologies

Specifically to help with:

- feeding/grazing
- health and welfare
- reproduction
- flock/herd management
- fattening and/or milking

Sm@RT – what do EU farmers have?



Top 3 technologies currently on all farms:

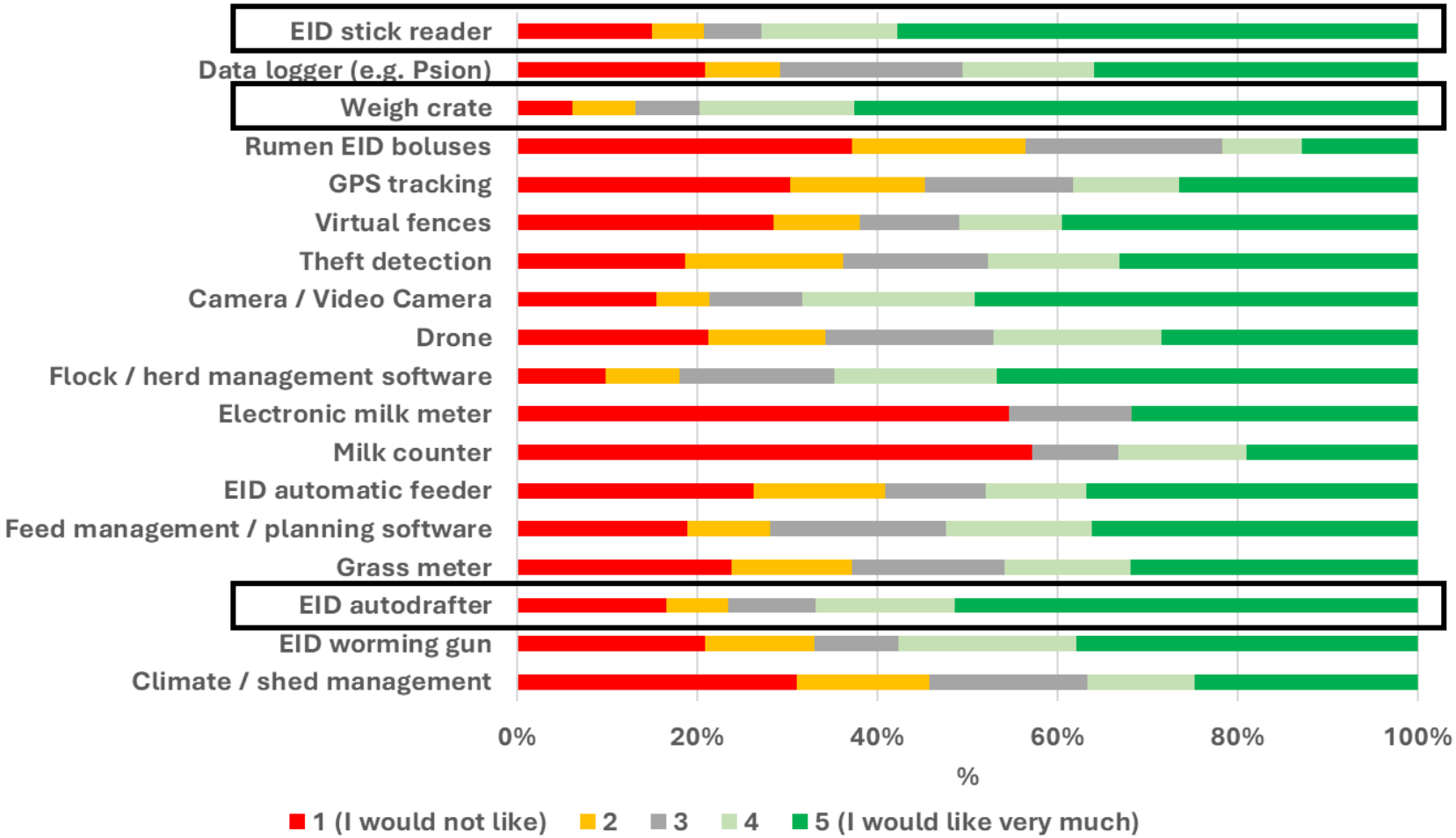
1.Weigh crate

2.Farm / herd management software

3.Camera / Video Camera

Sm@RT – what do EU farmers want?

*assuming tech is free



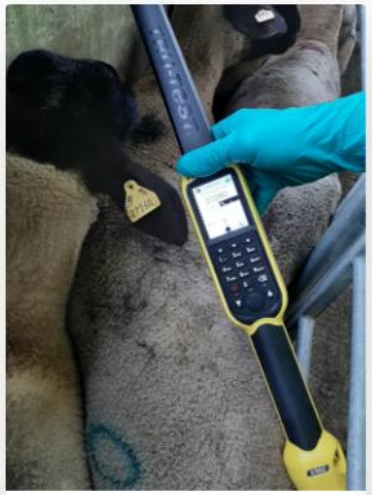
Top 3 technologies that farmers would like very much:

1. Weigh crate
2. EID stick reader
3. EID autodrafter

Information available:

Cost / Benefit Analysis

www.smartplatform.network/



Cost / Benefit Analysis

Cost / Benefit Analysis: EID stick reader

Cost / Benefit Analysis: EID stick reader

Cost / Benefit Analysis

Cost / Benefit Analysis: Drone

Cost / Benefit Analysis: Drone

Cost / Benefit Analysis

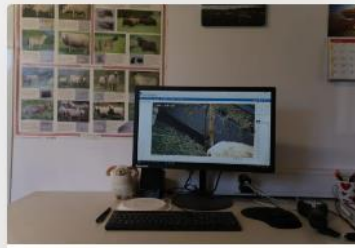
Cost / Benefit Analysis: GPS collar / E-bell

Cost / Benefit Analysis: GPS collar

Cost / Benefit Analysis

Cost / Benefit Analysis: Virtual fence

Cost / Benefit Analysis: Virtual fence



Cost / Benefit Analysis

Cost / Benefit Analysis: Flock management software

Tool / Technology: Farm management software Analysis prepared by (country): Production type the tool/technology is relevant for: Dairy / Meat / Both Description of the "benchmark" farm for which the analysis is performed: Country: Israel Production type: Mainly outdoors / Housed 0-3 months a year / Housed 4-8 months a...

Cost / Benefit Analysis

Cost / Benefit Analysis: Autodrafter

Cost / Benefit Analysis: Autodrafter

YouTube: H2020SmaRT

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Sm@RT – Sm@ll Ruminant Technologies - is a European wide network to encourage t ...more

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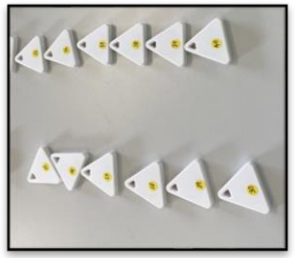
Shorts

Sm@ll Ruminant Technologies

TechCare – Bluetooth Low Energy (BLE) devices for real-time monitoring in extensive systems

BLE beacon 14g



Advertising

- Beacon ID
- Beacon signal strength (RSSI)
- Every 1285ms

BLE Reader (WISP) 330g

- BLE reader
- GPS (GNSS)
- Accelerometer

LoRa Gateway

Network Server (The Things Network)

Application Server (ArcGIS)

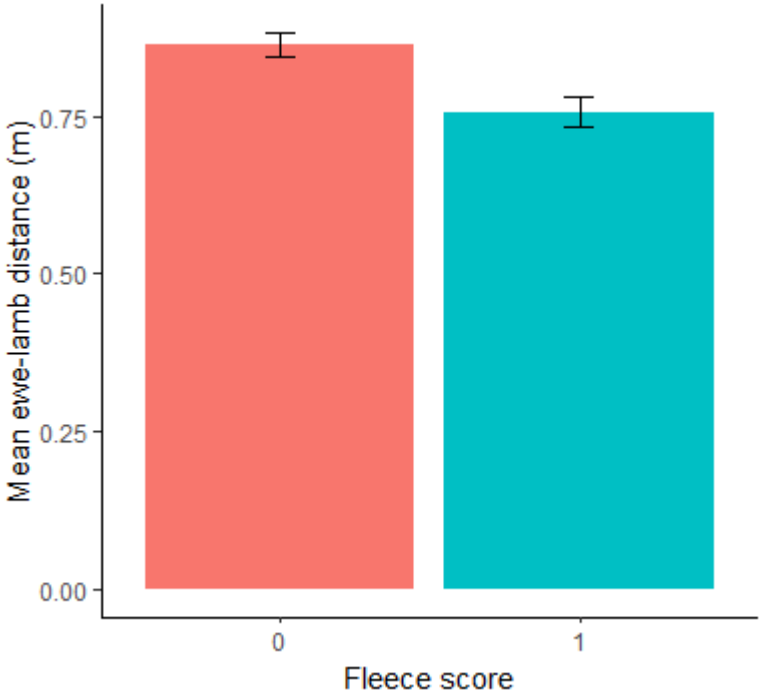
Data

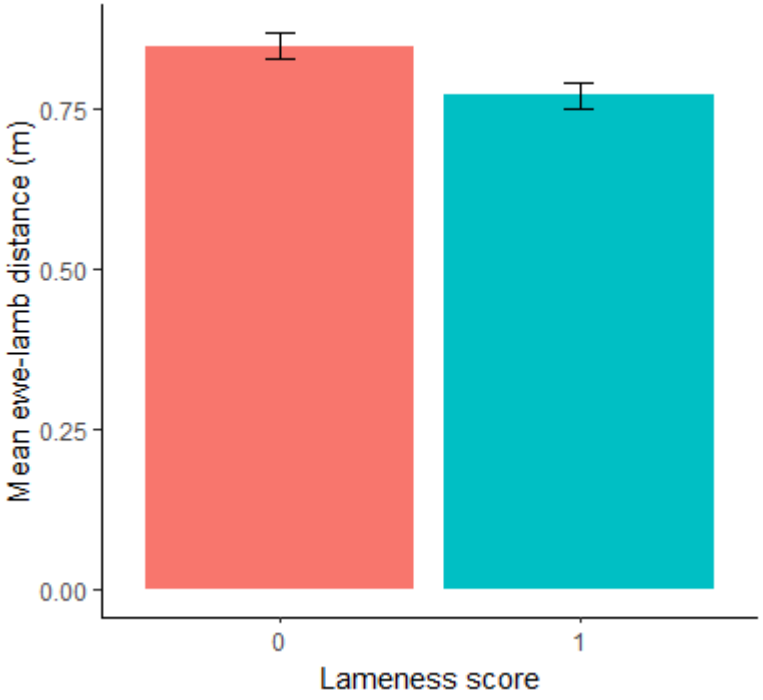
Every 5 mins:

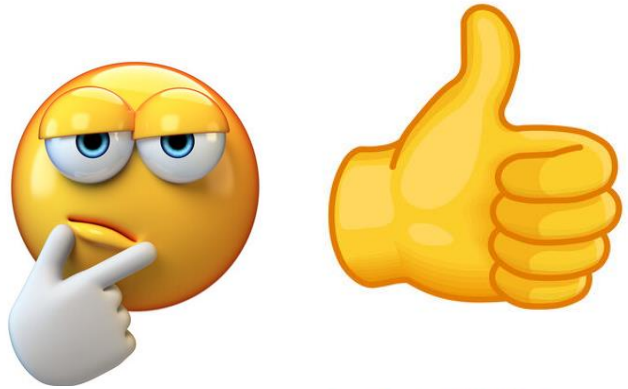
- **GPS/GNSS** (average of min 10 fixes)
- **Accelerometer** (highest RMS - 30s interval)
- **BLE Reader** (identity & RSSI of the **16 closest beacons**)

Bluetooth beacons: measure ewe welfare

Healthy ewes had a greater distance between then and their lambs than ewes with either lameness or fleece problems







TECH CARE

Integrating innovative TECHnologies along the value Chain to improve small ruminant welfARE management

Pipeline of tools being developed/available

Research on-going

Commercially available

Outdoor/walk over weighing
GPS/location for health management
Bluetooth Beacons
Tri-axel activity monitors
Diurnal behaviour patterns (GPS)
Variation in group/mob behaviour
Molecular species identification of larvae/eggs

**But, few of these are working towards early detection of disease

Automatic FEC tools

Alerts from parasite epidemiology

Electronic ID tags (EID)

EID/weigh crates/automatic drafting gates

App for TST (weight based worming)

GPS/mobile location/tracking

Aim of PLF tools for helminth infections

Optimise wormer use:

"As little as possible, as much as needed"

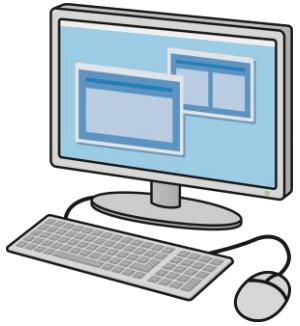
Measure the weight gain of some animals

MEASURE to MANAGE
Use EID to **record** individual weights

LOOK at the data

Ask Questions- Are the animals growing as you would expect? If not, why not?

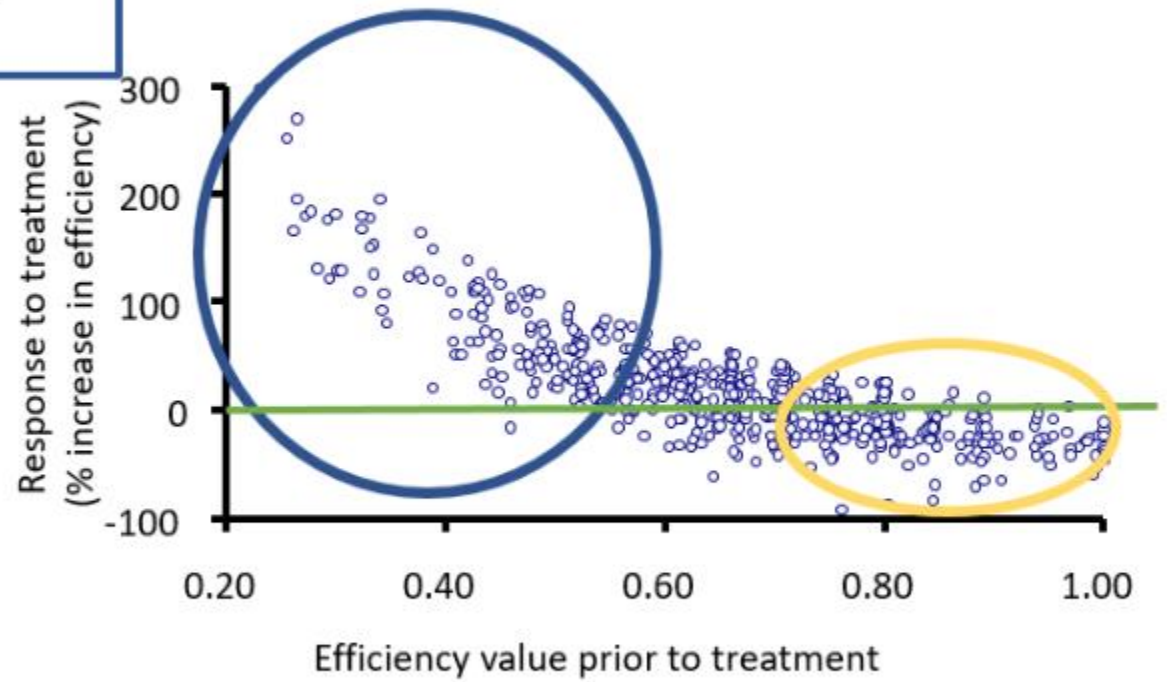
Check your pasture



Use a **software package** to collate all this data to allow you to make **informed decisions** on any **interventions**

PLF for helminth infections: individual variation in lambs - weight gain post-wormer

Underperforming lambs that show increase in performance post-worming



Well-performing lambs that show no increase in performance post-worming

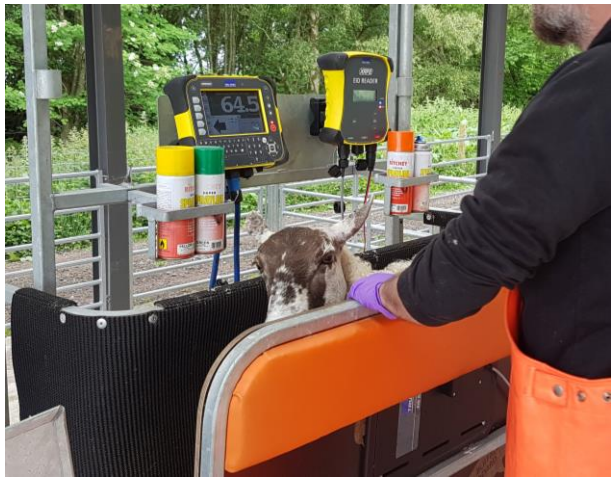
Greer et al, 2009, Vet Parasitol. 164, 12-20

Example: Performance-based Targeted Selective Treatments for helminth infections

Tools are relatively simple

Electronic ID tags

Electronic weigh scales

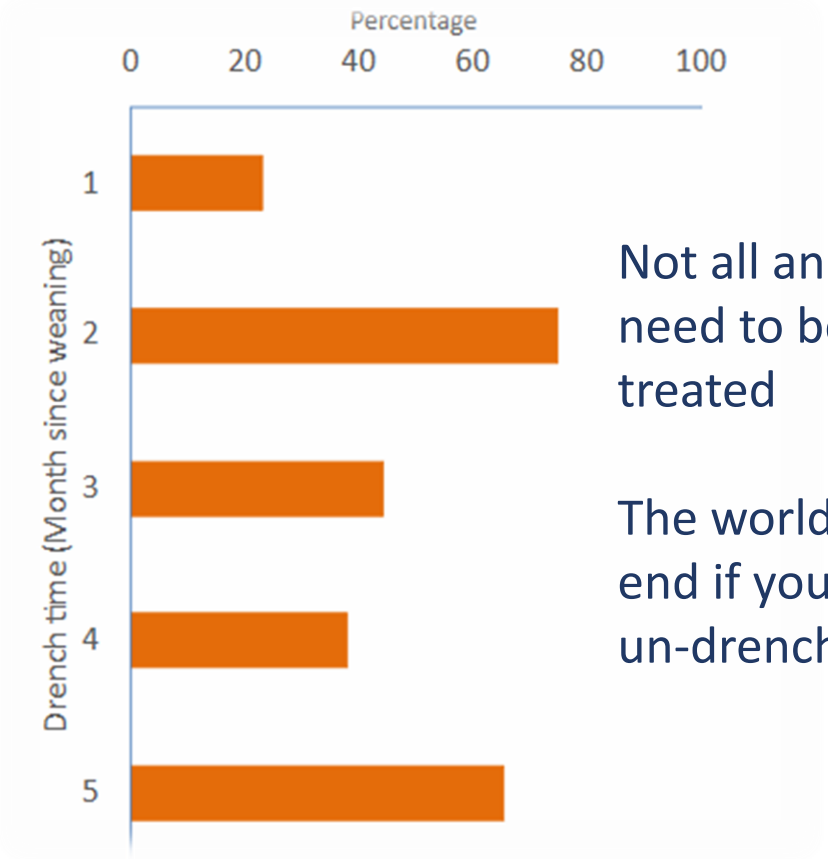


Automatic shedding

Objective is to targeted treatment to underperforming animals that are likely to need it

RFID and liveweight gain for determining need for treatment

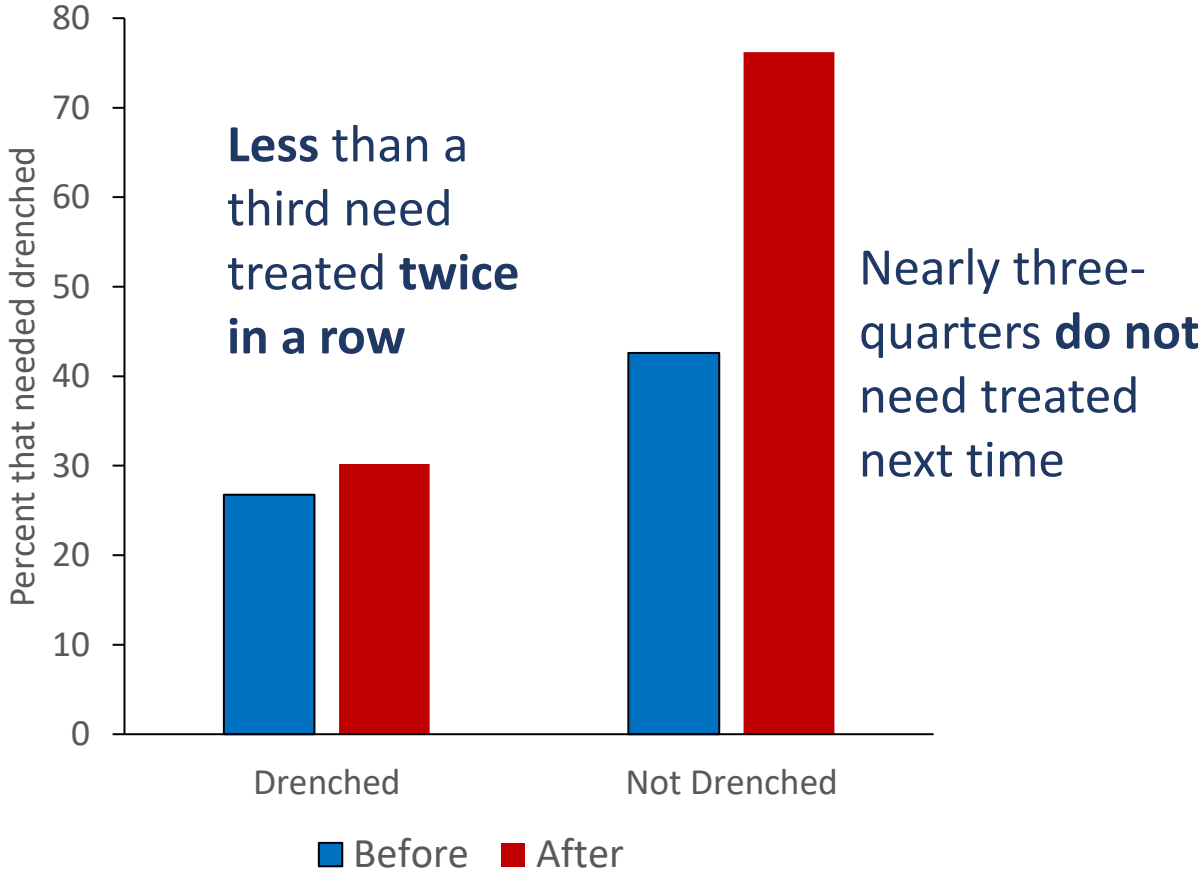
Of whole mob at each decision time



Not all animals **always** need to be need treated

The world **does not** end if you leave some un-drenched!!!

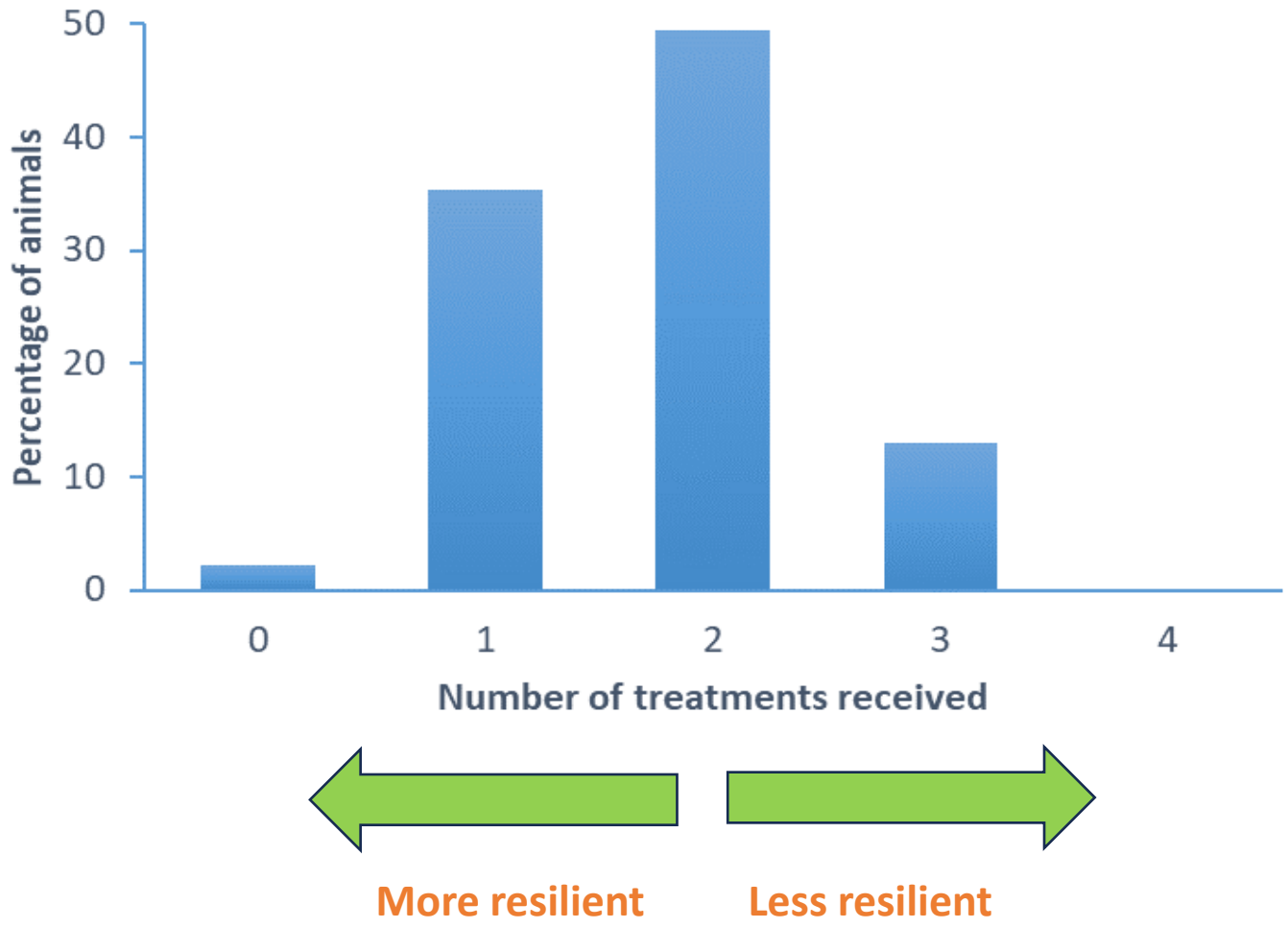
For only those that were treated



Less than a third need treated **twice in a row**

Nearly three-quarters **do not** need treated next time

RFID and performance-based treatment reduces drench input



More resilient animals grow **better** and required **fewer** treatments

Marketing advantages – responsible/sustainable use of chemicals

Added benefits selection based on No treatments given

Doses	n	Overall	Reproduction	Survival
1	20	1592[a]	539[a]	233[a]
2	183	1234[b]	344[b]	156[a]
3	150	1183[b]	343[b]	130[a]
4	18	1011[b]	126[c]	-1.9[b]

Greer et al., 2013, PNZSAP, 73, 175-179

Index's for Growth, Adult size, Meat yield, Wool **not different**

Number of treatments used to select replacements with **no** negative impact on **genetic potential** for production traits

Movement (GPS)

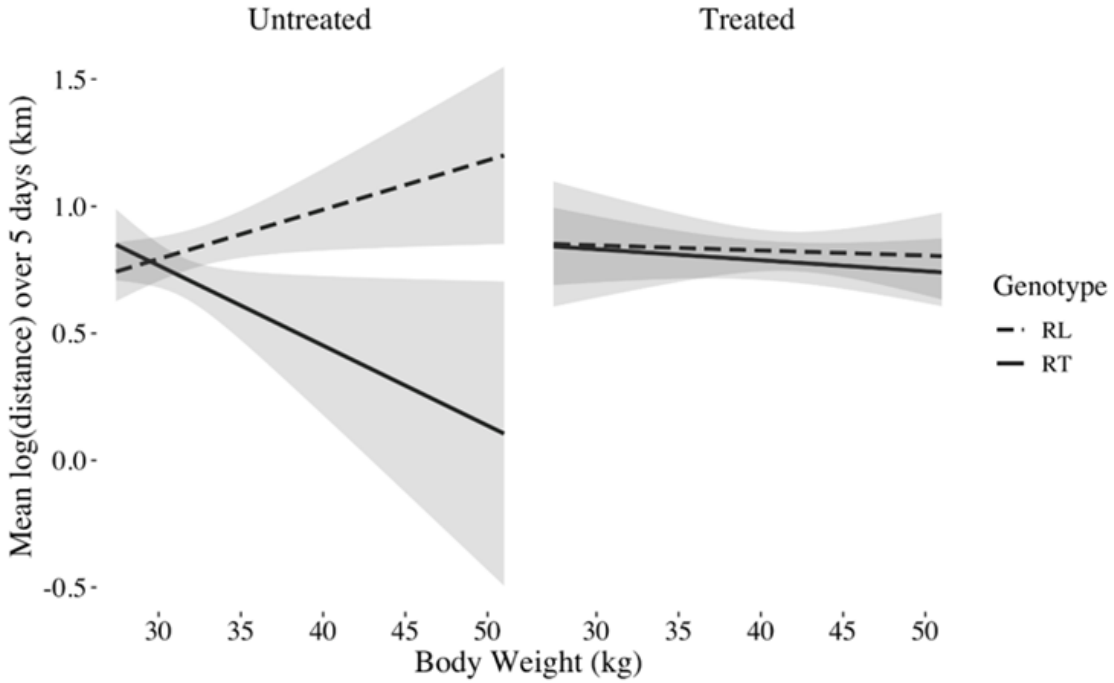
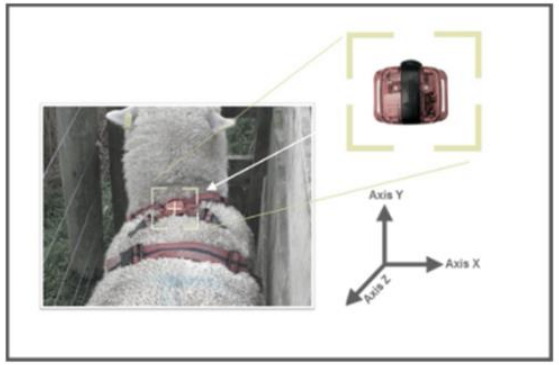


Fig. 1 Effect of anthelmintic treatment on the mean daily movement (95% confidence interval) of resilient (RL) and resistant (RT) Romney lambs dependent on live weight.

Seer Ikurior, PhD Thesis

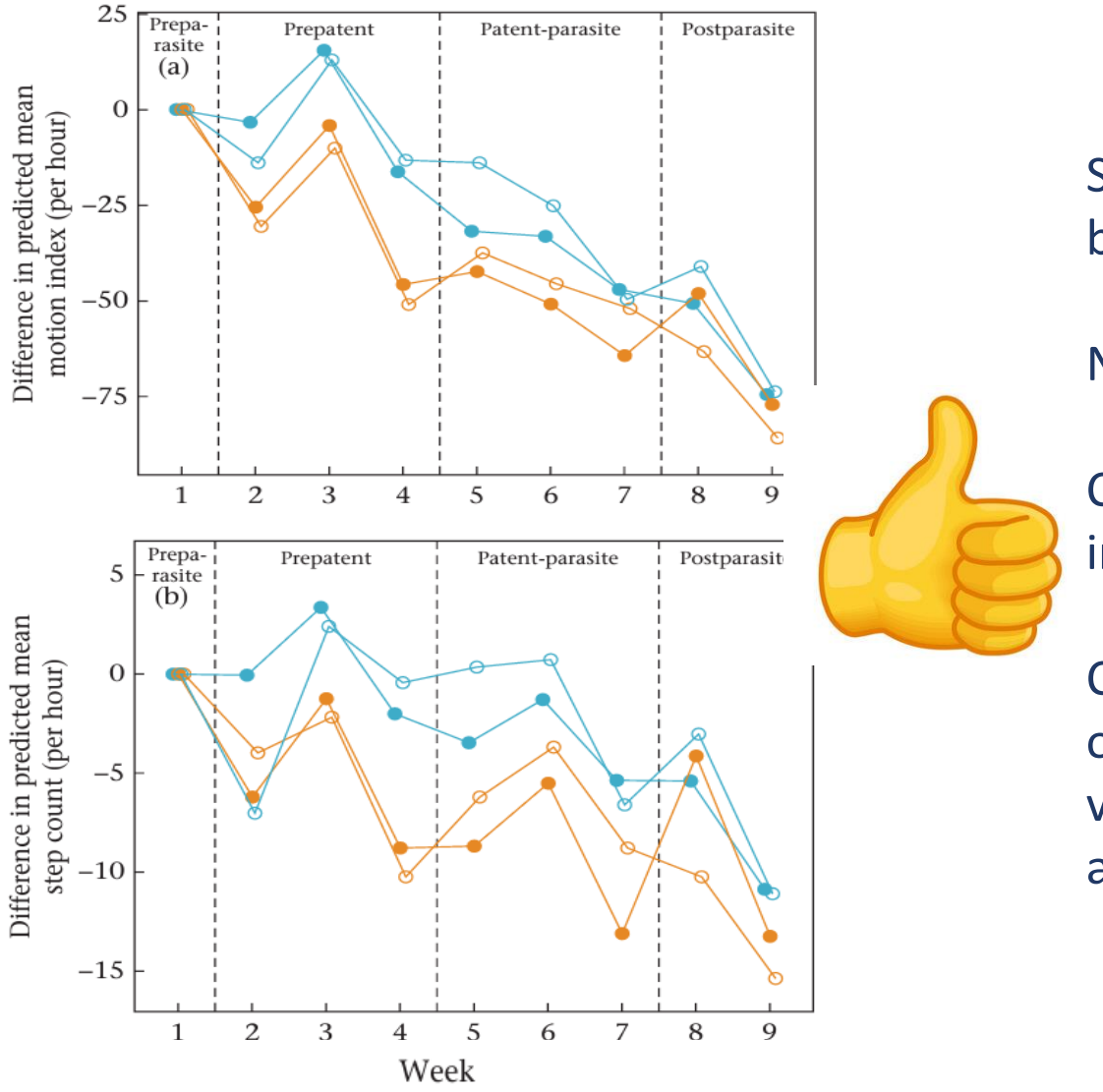
Veterinary Parasitology 283 (2020) 109188



Less movement in parasitised animals

Genotype x weight interaction:
Evident in **heavier** and in **resistant** but not **resilient** lines

Activity with tri-axial accelerometers



A. M. M. Morris et al. / Animal Behaviour 193 (2022) 157–179

Several studies have investigated animal behaviours with accelerometers

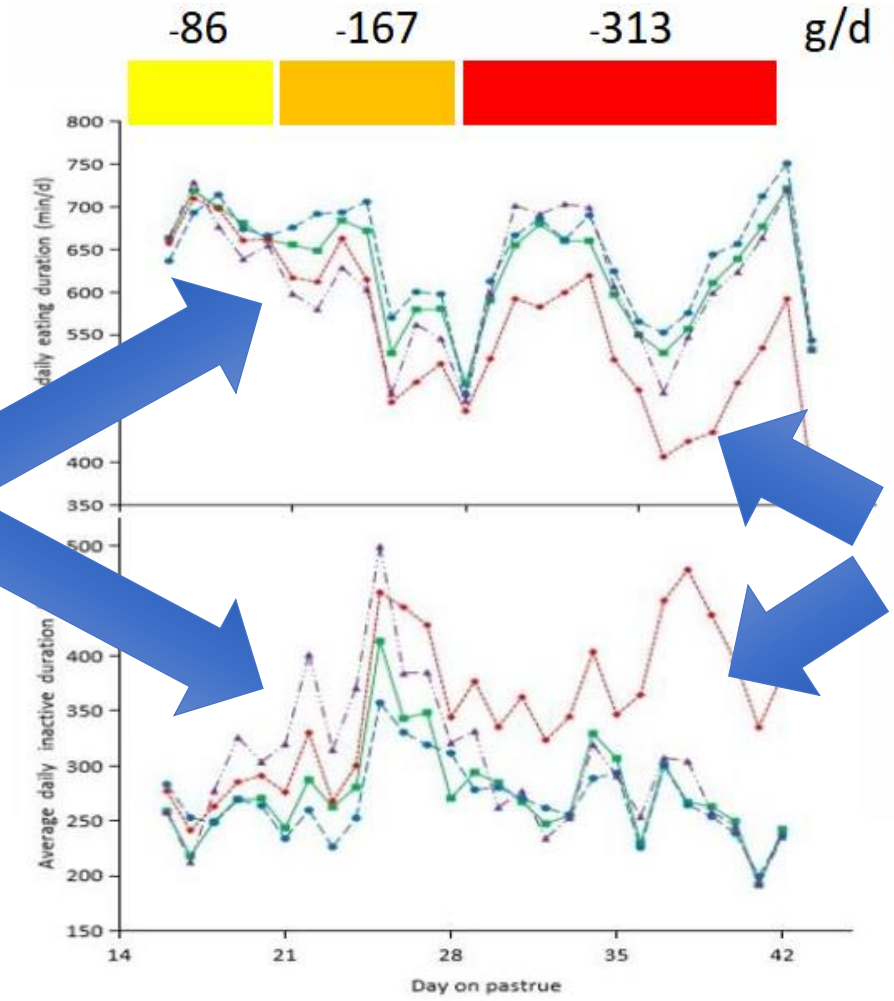
Not all behaviours consistently show an effect

Commonly **less movement** and **less grazing time** in parasitised animals

Challenges in interpretation/comparison based on what constitutes each activity. Requires validation of each sensor and commercial algorithms may not be known

Is activity timely? - sheep

LWG relative to uninfected



Prior to day 28:

No difference in behaviour

Already **some** production loss

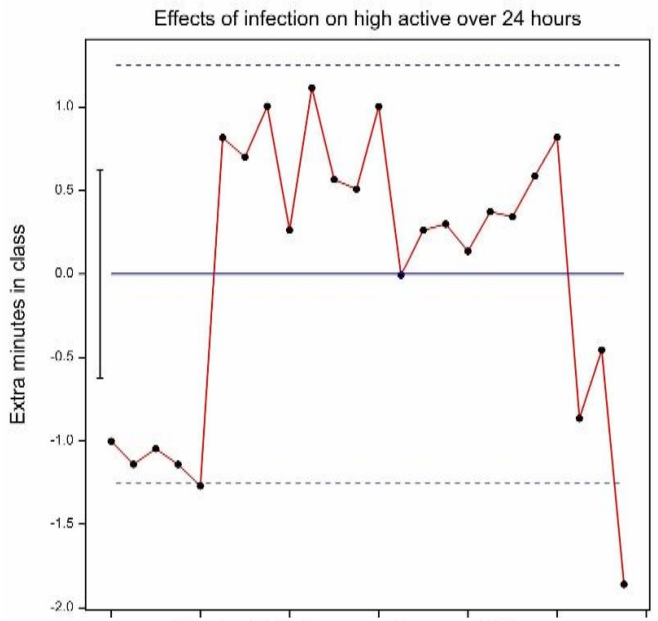
From day 28:

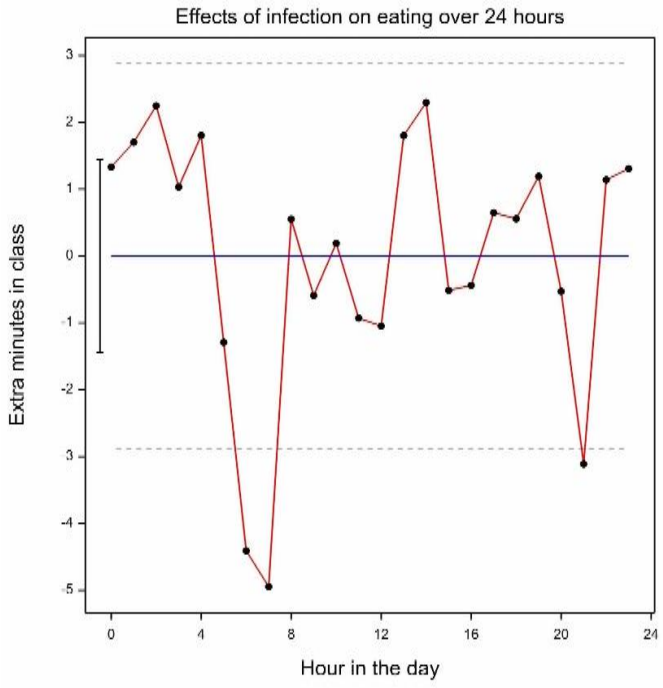
Clear difference in behaviour

Clear difference in production

Bowen Fanwell PhD studies

Diurnal activity



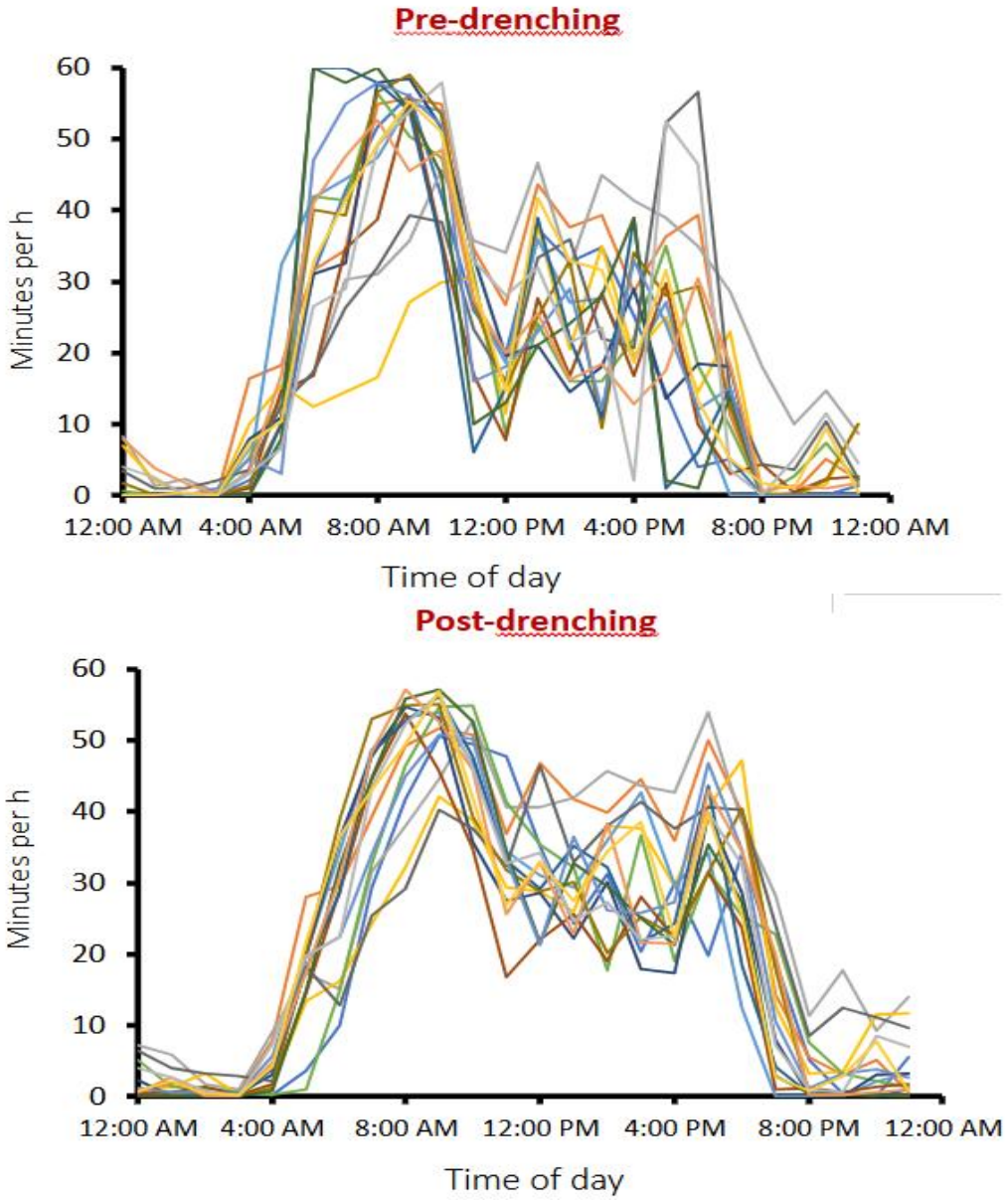


Evidence parasitism **may** influence diurnal patterns of behaviour

Could variation in diurnal patterns be more sensitive? Further work required

Bowen Fanwell PhD studies

Variability in activity as an indicator



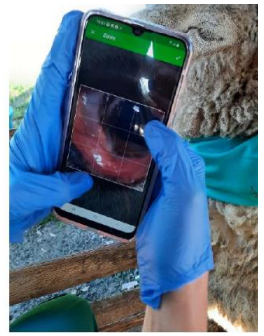
Mean co-efficient of variation **reduced** by **28%** post-drenching

Able to identify when the most susceptible of the mob is affected?

Reduced costs – using **sentinel** animals within a mob = **increased** likelihood of adoption

Summary

PLF offers opportunities to collect data. Some examples of effective use but many still require fine tuning

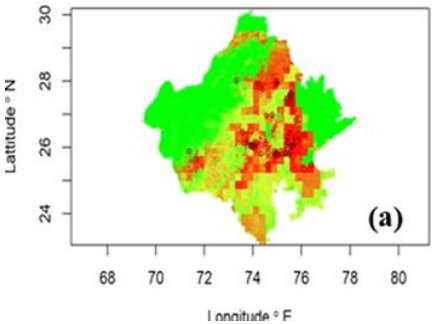


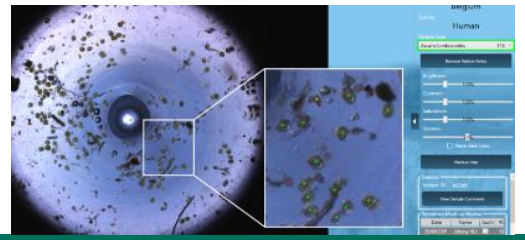
Adoption of PLF for small ruminants has its challenges

Farmer willingness
Comparatively small and unique market (new product development)
Cost relative to value of the animals

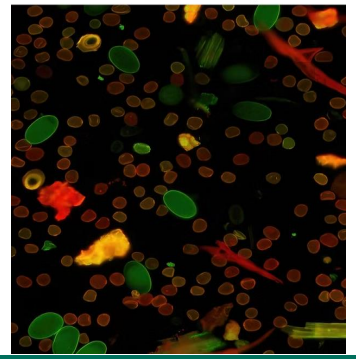
But…availability of tech for PLF and worm control has increased

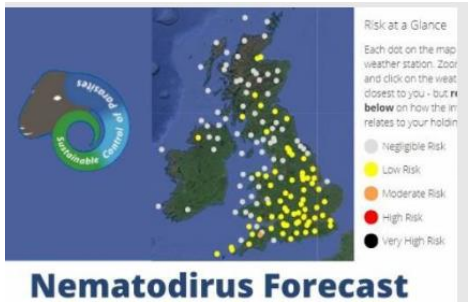
Has got cheaper - but still requires investment
More comprehensive - which means more complex
AI and automated systems and warning tools





Parasight System Inc Animal Health Technology

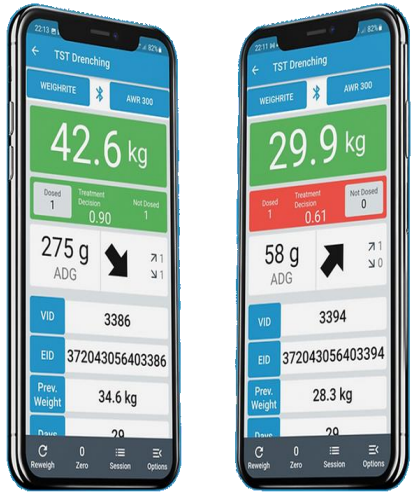




Summary

Existing on-farm options based around RFID and live weight

- Relatively cheap but simple tags
- Investment in farm infrastructure (weigh facilities/readers)
- Improved drug use (refugia/responsible use of anthelmintics)
- Potential additional benefits from genetic selection and marketing



Summary

More complex measurements of animal behaviour

Proof of concept shown but still largely in research phase

GPS, proximity or Tri-axial tags (expensive and limits on battery life)

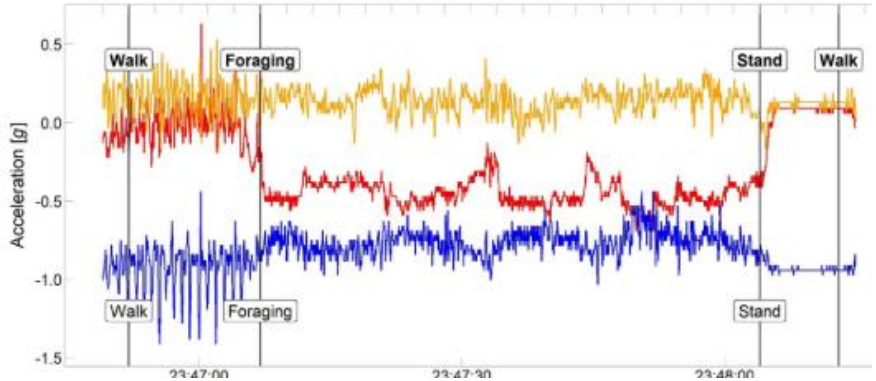
Large volumes of data that require analysis

Apps/Tools available for other species (cattle)

Measurable differences in animal behaviour due to parasitism

Additional advantages for overall grazing management

Perhaps better suited to the use of sentinel animals and variation?



And finally....

PLF has the potential to cause a quantum shift in the way animal health challenges, particularly nematodes, are identified and treated on-farm

Some options are farm-ready, some are still needing development

All require investment in either infrastructure, tech or training

'If you always do what you have always done, you'll always get what you always got' *Henry Ford*

Thanks to……

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Bowen Fanwell
James Meyer
Cassie Terras

Jade Duncan
Gillian Mitchell
Leigh Andrews
Adam Hayward
Heather McDougall
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Claire Morgan-Davies
Ann McLaren
Ailsa Thomson
Cathy Dwyer
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Aimee Walker

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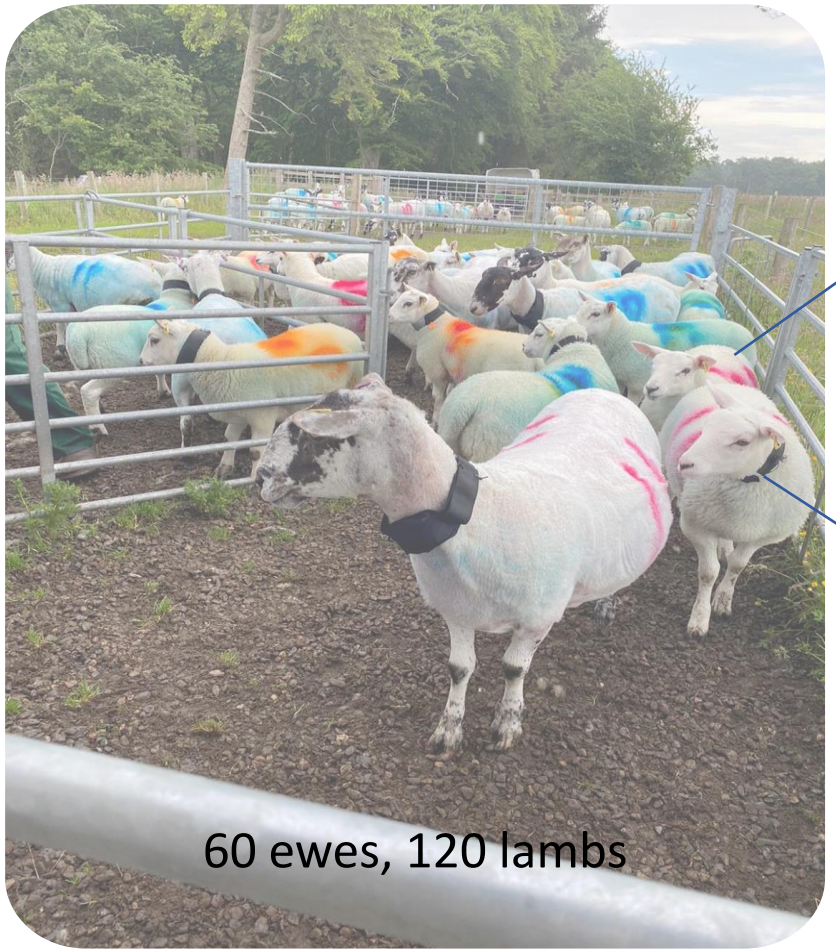
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 862050

TechCare – Can technology improve animal welfare and health?



April to Oct (UK); 2 years

Daily: focal behavioural samples

Scan samples

Lameness scores

Ewe:lamb distance

Weekly:

Qualitive behavioural assessment (QBA)

Fortnightly:

Animals scored on welfare for:

Dag, Body Condition, Fleece, Dental, beathing and injuries

Weight

FEC

TECH CARE

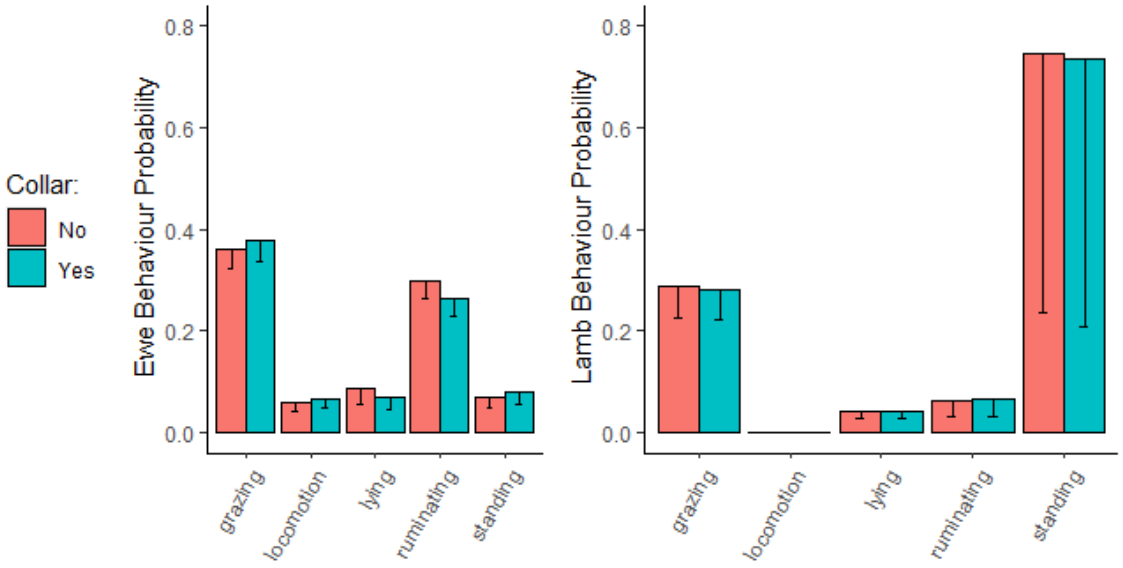
Integrating innovative TECHnologies along the value Chain to improve small ruminant welfARE management

TechCare – does wearing tech CAUSE welfare issues?

No significant differences in lambs/ewe wearing/not wearing collars:

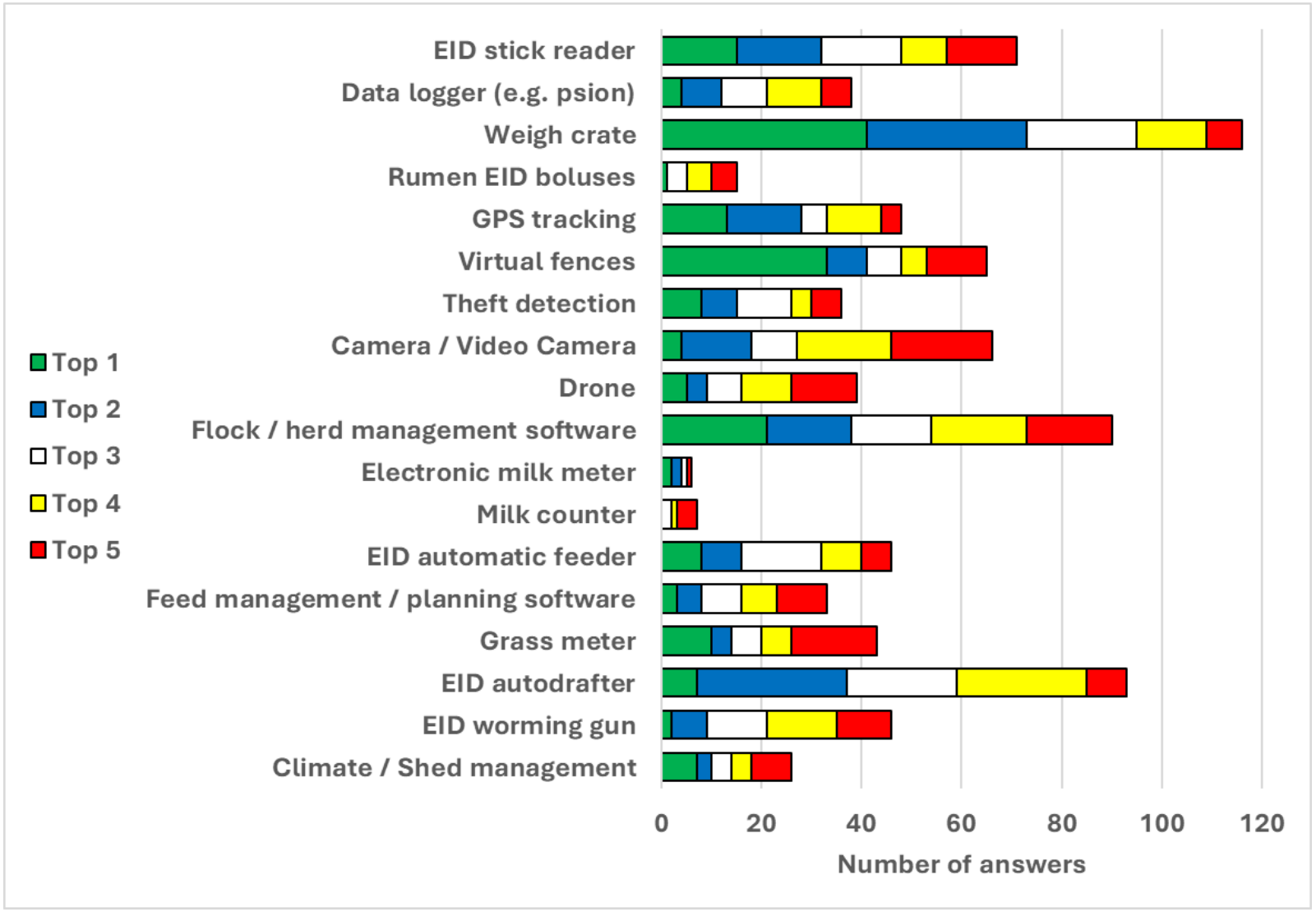
- No damage to skin
- Play/suckling behaviours
- No differences in QBA (arousal or sociability)
- Ewe welfare indicators (lameness, mastitis, FEC)
- Lamb welfare indicators (lameness, Dag, FEC)

- BUT lots of different types of tech and attachment styles, so this is for OUR system in OUR sheep!



Integrating innovative TECHnologies along the value Chain to improve small ruminant welfARE management

Sm@RT – what do EU farmers think would be most beneficial?



Top 3 technologies that farmers deemed most beneficial (selected top 1):

1. Weigh crate
2. Virtual Fences
3. Flock / herd management software

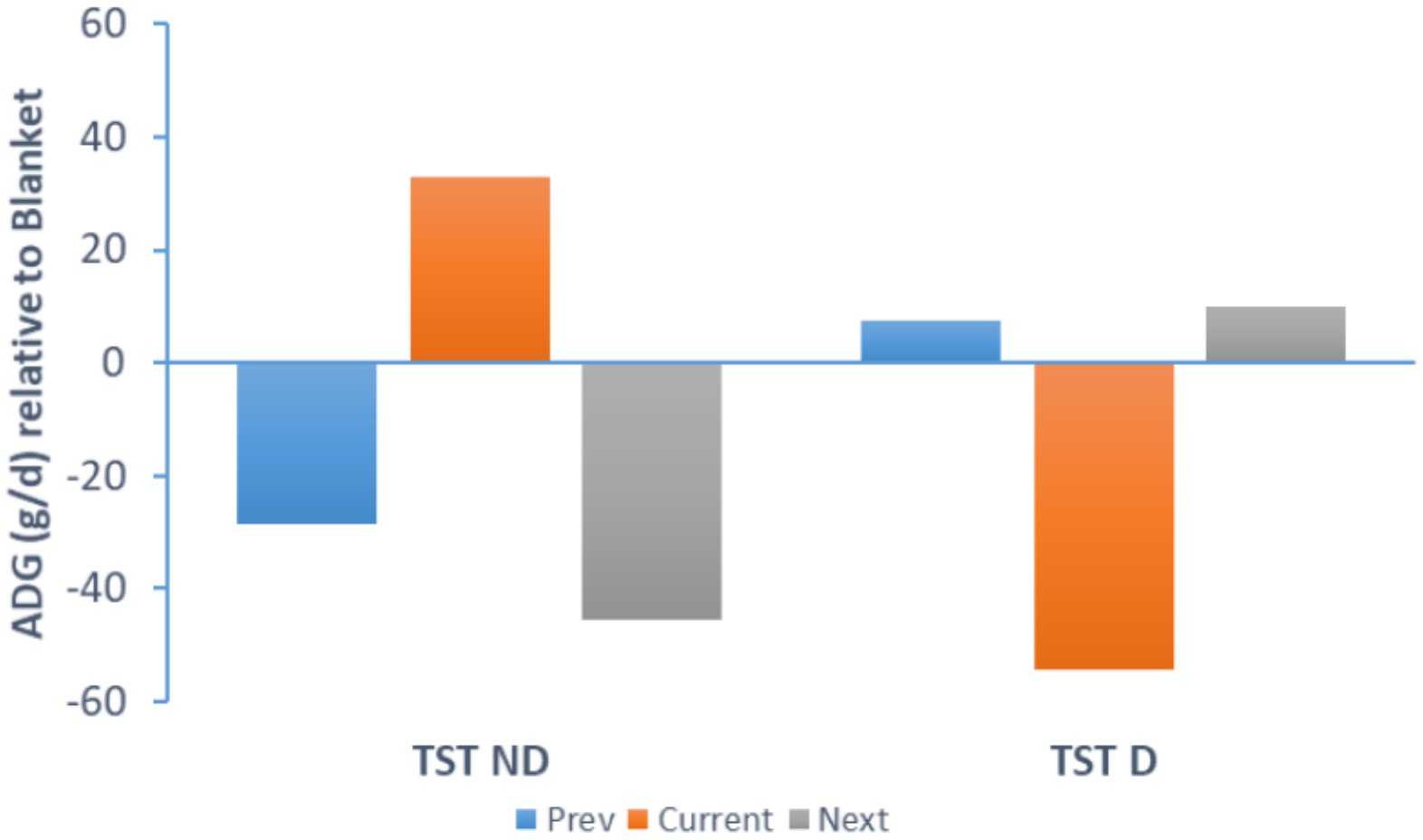


Figure 11: Average daily gain (ADG, g per d) for TST animals that were either not drenched (TST ND) or were treated (TST D) relative to the Blanket treatment on each farm for the period when the assessment for need for treatment took place (Current), in the period preceding the current period (Prev) or the period following the current period (Next).

Table 3: Subsequent performance (ADG) and proportion treated (D) or not treated (ND) at each sampling time (V1…V4) relative to previous history and proportion of TST treated and their performance relative to Blanket treatment for each measurement period.

V1	V2	V3	V4	Overall
			n=51	
			ND 0.03	
		n=283	58.4 g/d	**82.4 g/d**
		ND 0.17		
		58.7 g/d	*n=232*	
			D 0.14	
	n=1086		-54.1 g/d	**61.7 g/d**
	ND 0.66			
	206.1 g/d		*n=529*	
			ND 0.32	
		n=803	62.9 g/d	**82.2 g/d**
		D 0.49		
		8.7 g/d	*n=274*	
			D 0.17	
			-21.6 g/d	**68.4 g/d**
n=1650				
1				
			n=27	
			ND 0.02	
		n=228	52.9 g/d	**80.4 g/d**
		ND 0.14		
		121.7 g/d	*n=201*	
			D 0.12	
			-42.9 g/d	**54.0 g/d**
	n=564			
	D 0.34			
	98.3 g/d		*n=229*	
			ND 0.14	
		n=336	63.4 g/d	**74.4 g/d**
		D 0.20		
		44.2 g/d	*n=107*	
			D 0.06	
			-17.9 g/d	**36.9 g/d**
TST proportion untreated	0.66	0.31	0.51	**0.48**
TST LWG	168.9 g/d	40.1 g/d	14.5 g/d	**69.6 g/d**
Blanket LWG	169.3 g/d	52.9 g/d	30.6 g/d	**79.9 g/d**

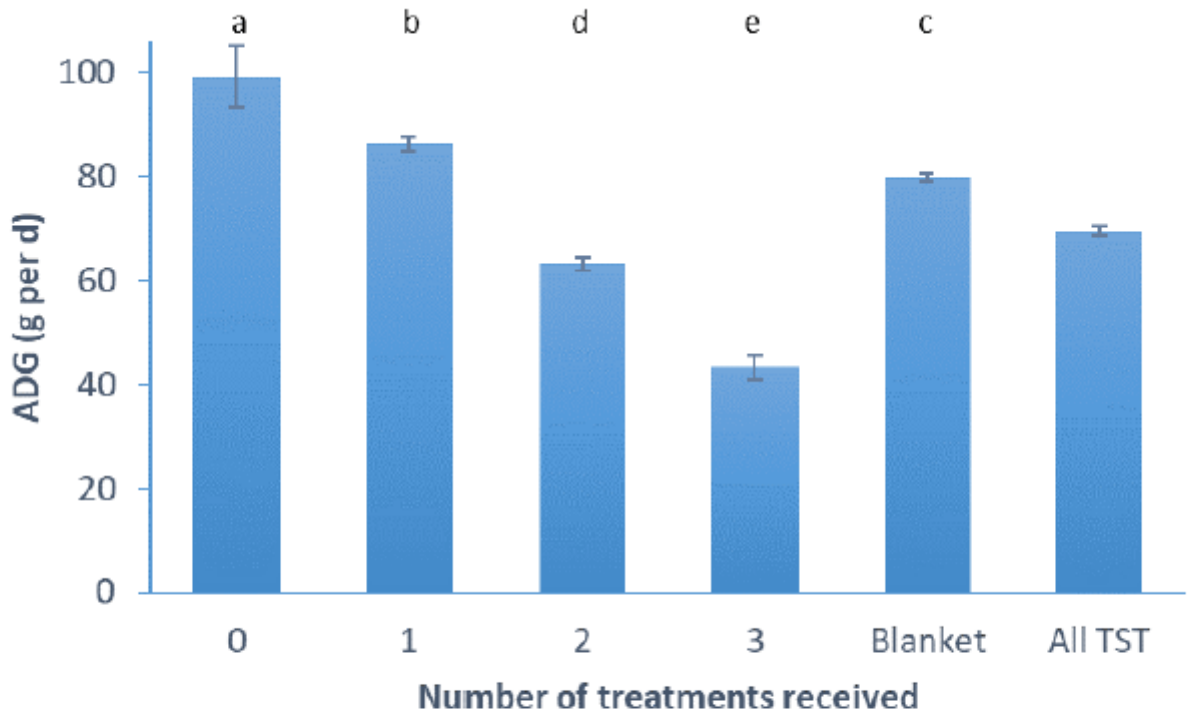


Figure 7: Average daily gain (ADG; g per d) over the entire period for all farms relative to the number of treatments administered to TST animals and Blanket treatment. The letters above each column represent statistical differences ($P<0.05$). Error bars represent the standard error of the mean (s.e.m). Note, the overall mean for TST animals is included for comparison and was not included in the statistical comparisons.

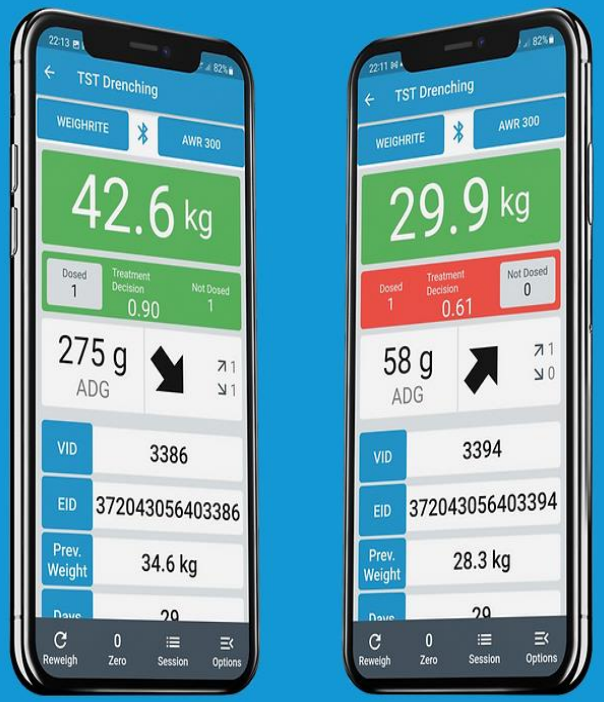
Accounting for nutrition/size: Happy Factor/SmartWorm

COTTER AGRITECH

Home Cotter Crate SmartWorm News Store Contact

Advanced Weighing and Selective Worming app

SmartWorm

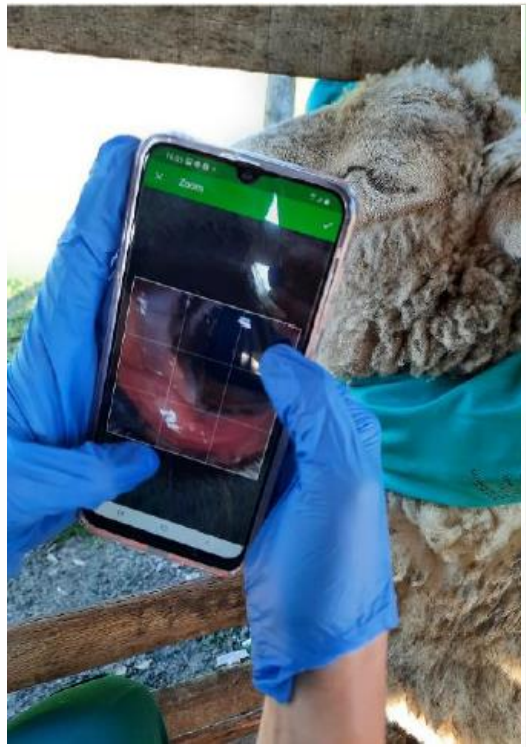


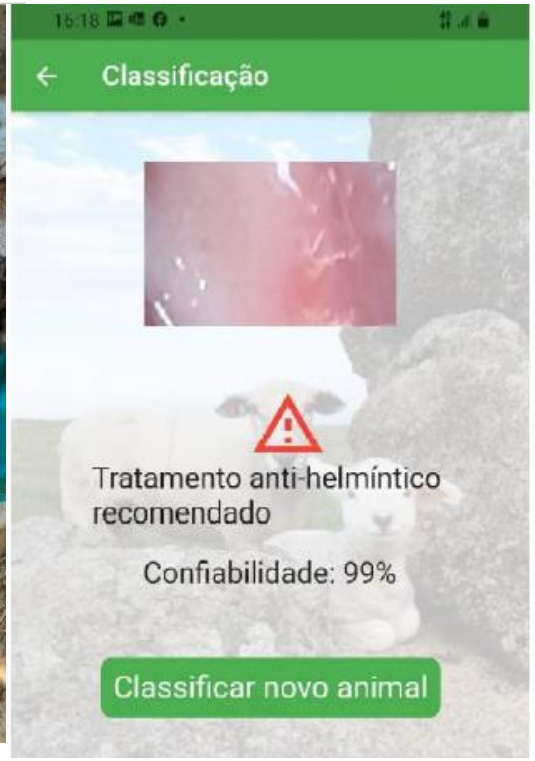
TACKLE WORM RESISTANCE

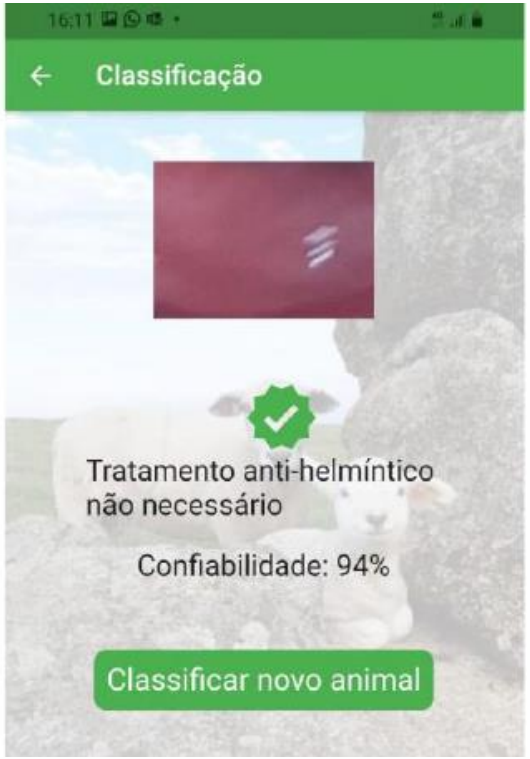
- Reduce wormer use by **40%** with no loss of performance with our selective worming algorithm
- Select replacements with **proven resistance/resilience to worms**, leading to further wormer savings
- **Slow wormer resistance**, protect your farms productivity and profitability

FAMACHA: gone high-tech

Score	Hematocrit	Coloration	Treatment
1	> 28%	red	no
2	23-27%	red-pink	no
3	18-22%	pink	yes
4	13-17%	pink-white	yes
5	≤ 12%	white	yes

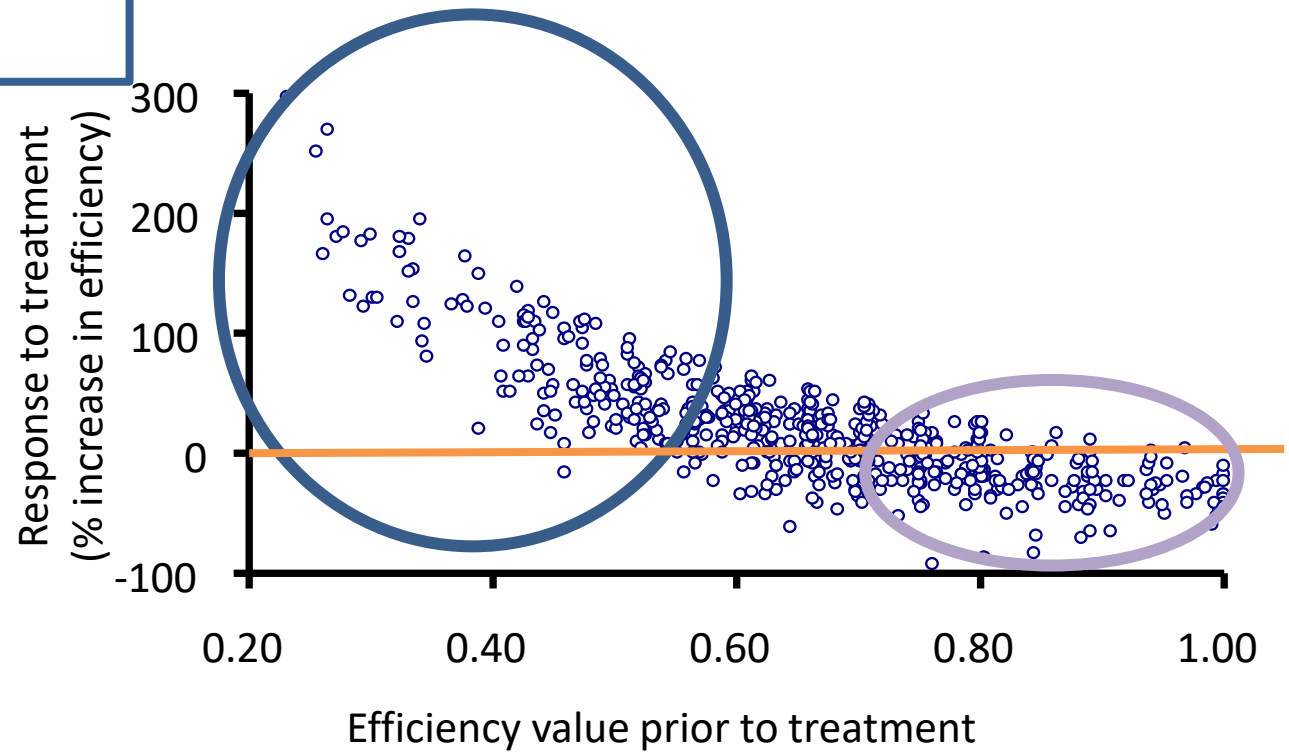






We can make wormers work harder for us by focusing treatment on those lambs that will respond to worming with increased efficiency of production

Underperforming lambs that show increase in performance post-worming



Well-performing lambs that show no increase in performance post-worming

Greer et al, 2009, Vet Parasitol. 164, 12-20

Outdoor weighing

Walk Over Weigh (WoW)

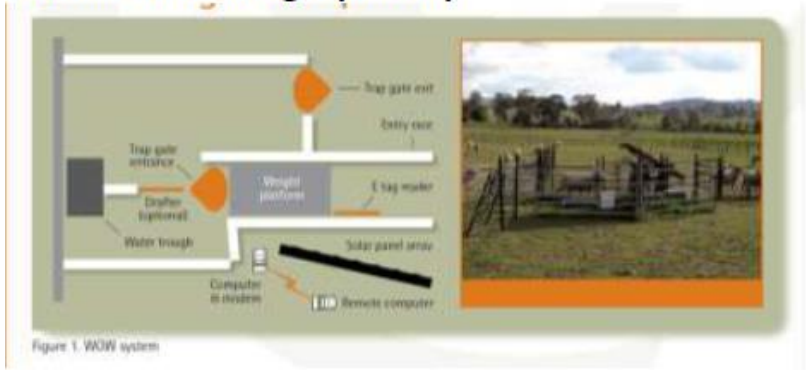
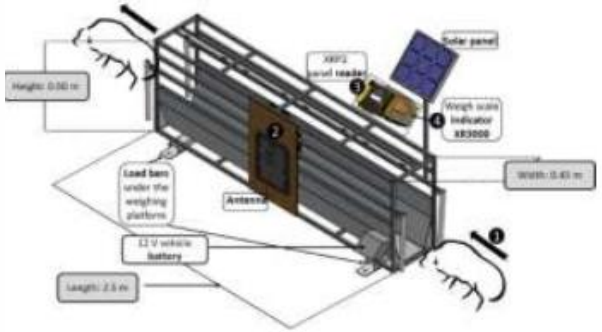
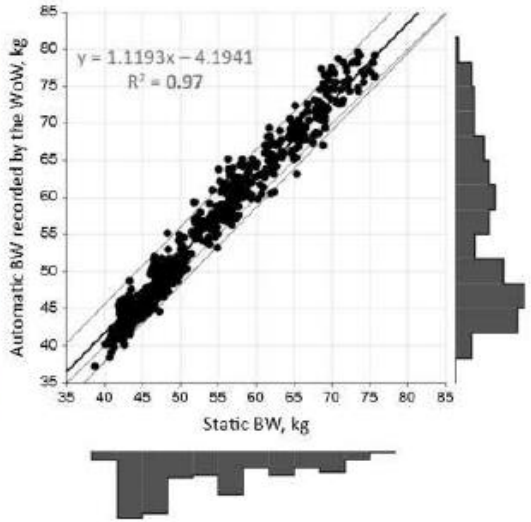


Figure 1. WOW system

Brown et al., 2012; 2014 (Sheep CRC, Australia)





González-García et al, 2018 (INRA, France)

Body Condition, Growth

Gautier et al. 2019 – Institut de l'Elevage, France

Supplementation

Vs.

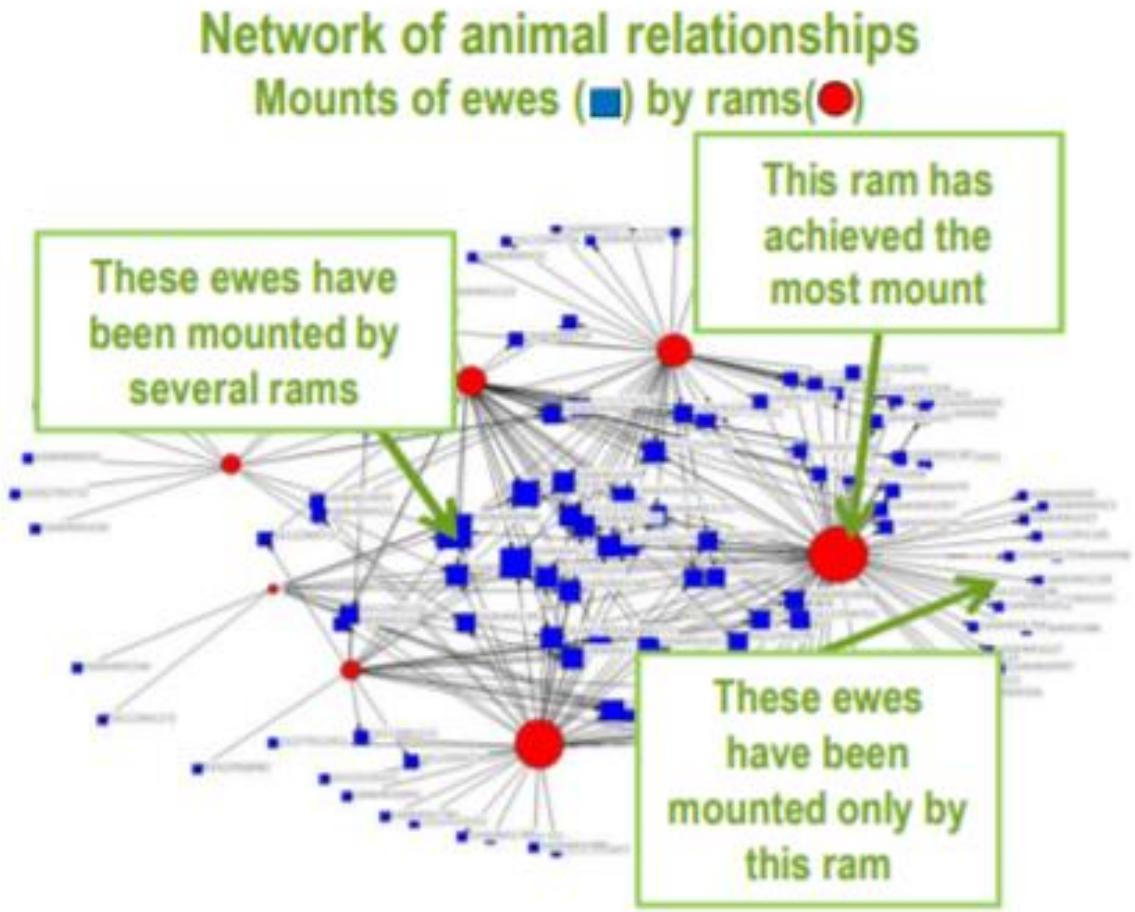
Wishart et al., 2015, SRUC, UK

Fencing

Nofence grazing technology

Alpha detector

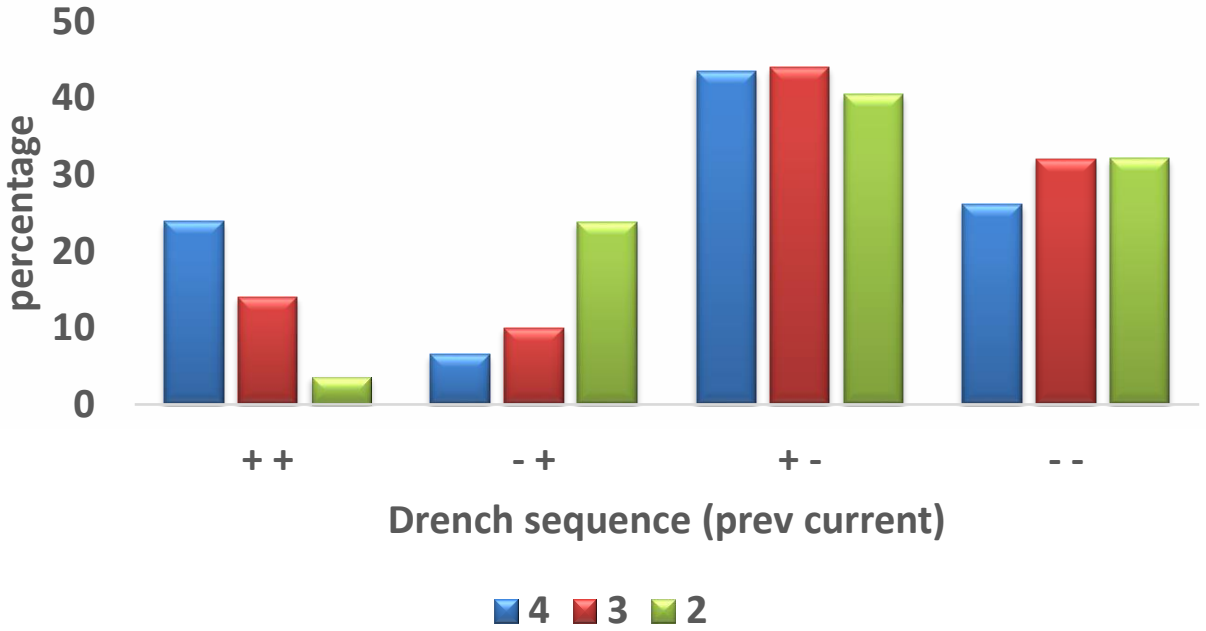
Alhamada et al. 2016; Debus, Menassol, Bocquier et al. INRA



Alhamada et al. 2016; Debus, Menassol, Bocquier et al. INRA

Effort v reward

Treat frequency	No. doses	LWG	LWG/drench	% reduction drench
2	2.1	9.7	4.5	28.6
3	2.0	9.4	4.8	34.7
4	1.6	8.3	5.1	46.4
Blanket	3.0	9.5	3.2	

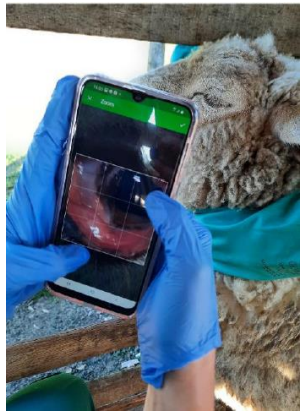


Tools, Animal-based technologies

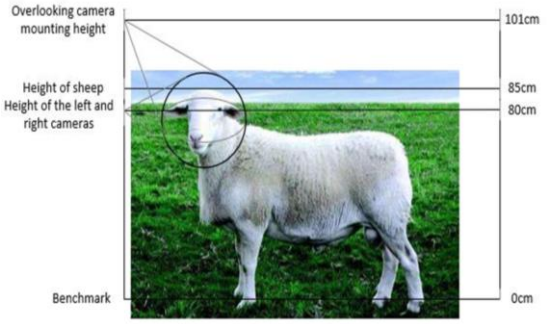
GPS/Proximity trackers

Tri-axial accelerometers

Apps

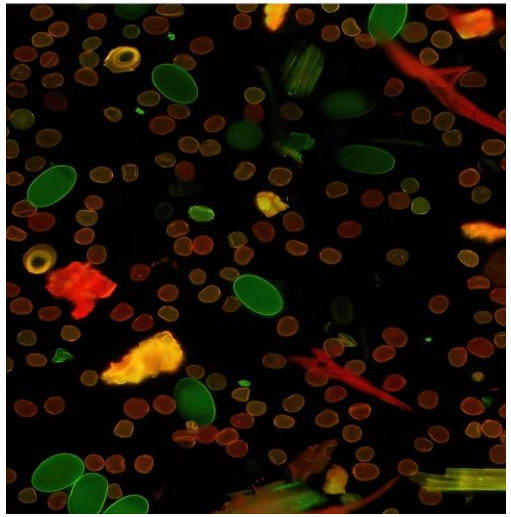


AI assisted tools

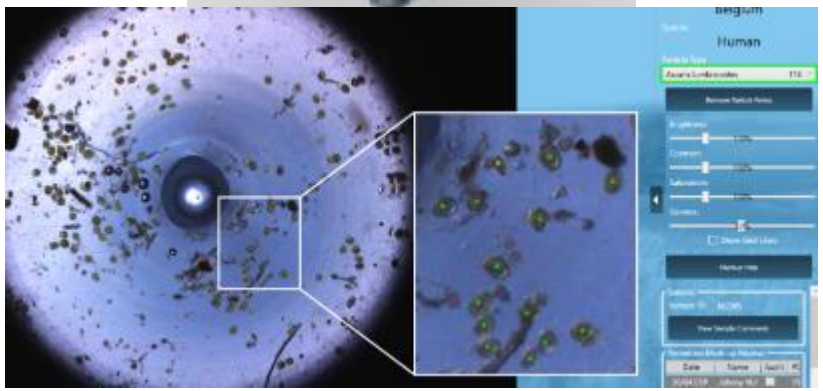


Tech improvements in diagnostics FEC

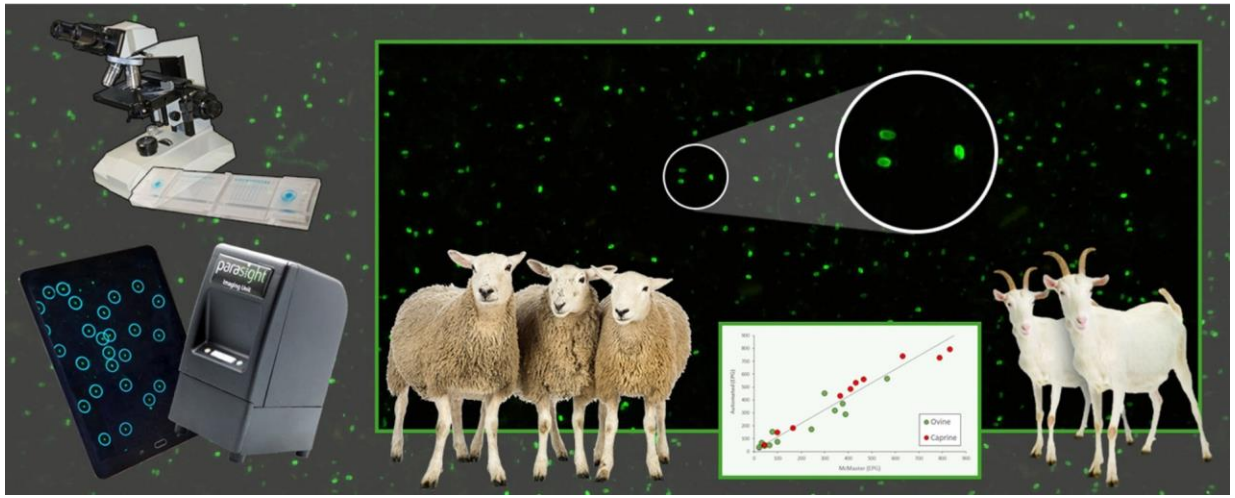
Parasight System Inc
Animal Health Technology



Retrieved from: https://www.parasightsystem.com/blank-1 21-01-25



Ayana et al. (2018). PLoS Negl Trop Dis 12(10): e0006655. https://doi.org/10.1371/journal.pntd.0006655



M. Slusarewicz et al. Veterinary Parasitology 276S (2019) 100020

Tech tools – AI assisted models of parasite epidemiology

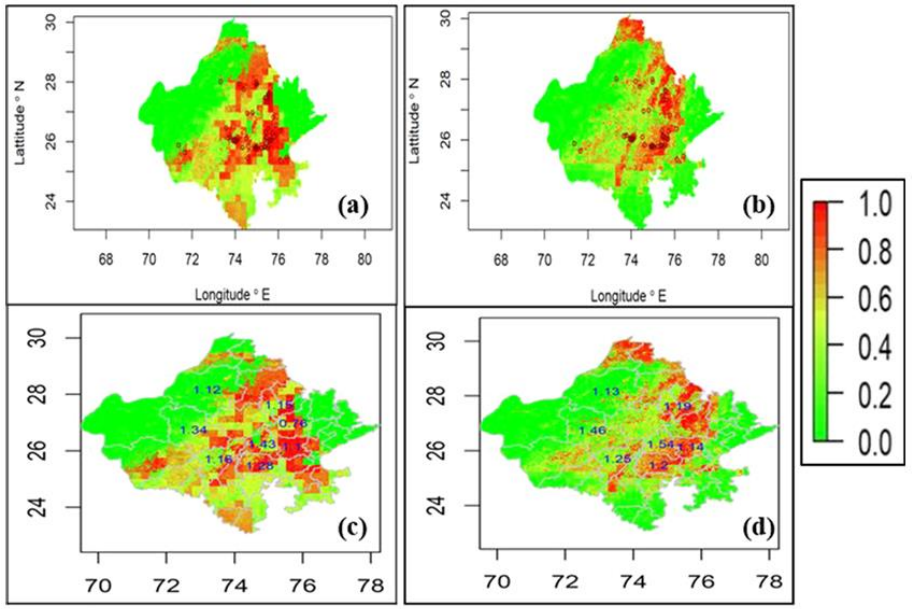
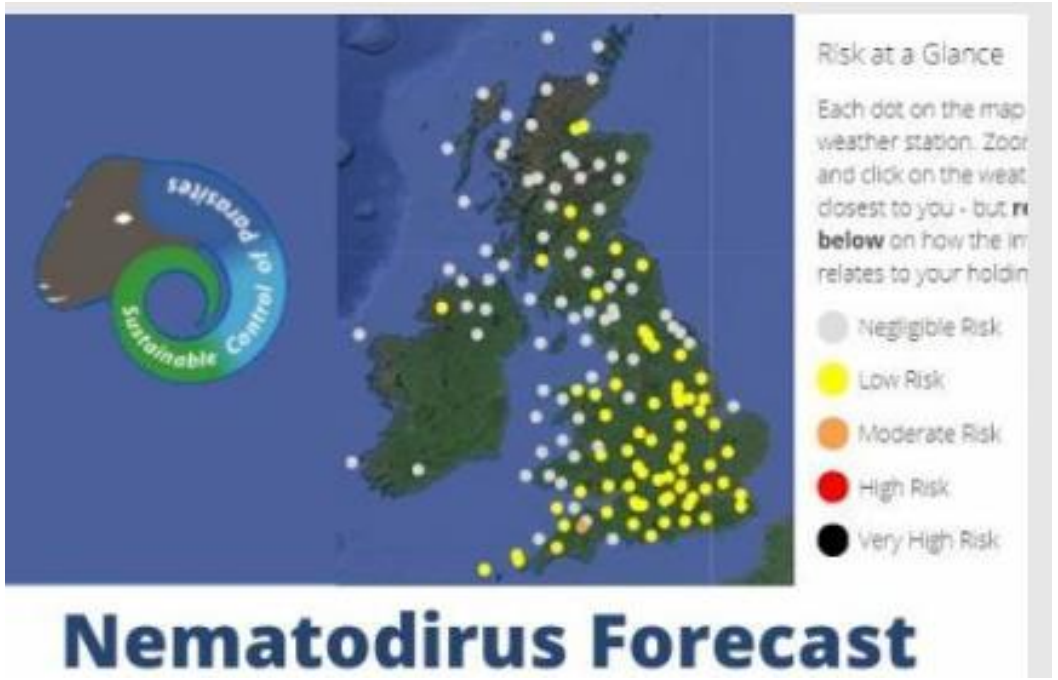
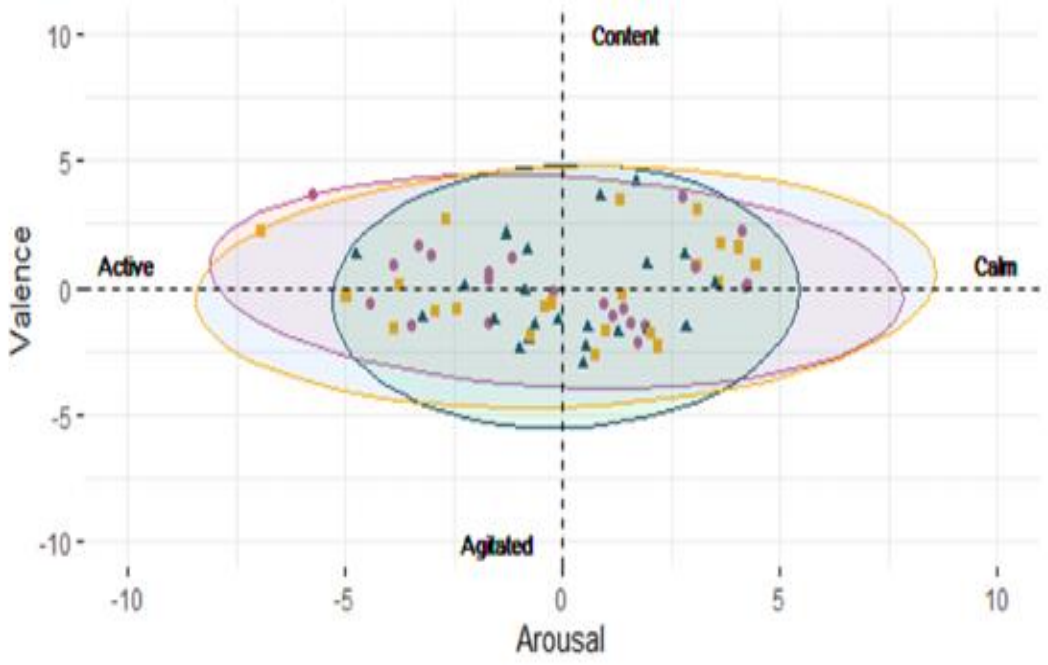


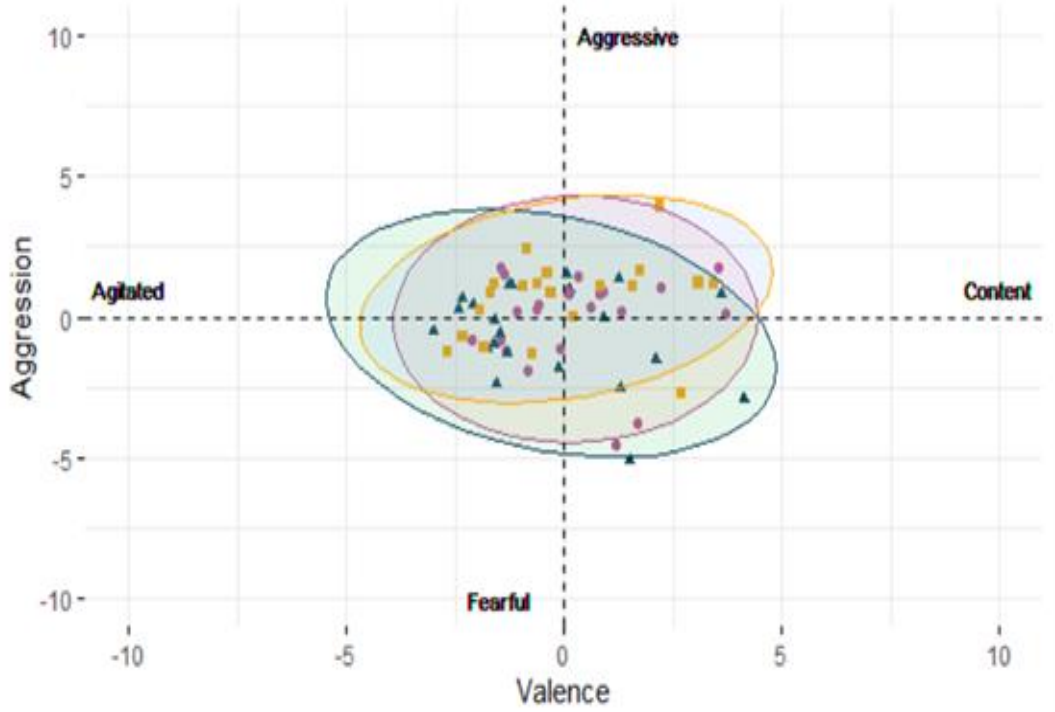
Fig. 5. Haemonchosis risk prediction map (2002–2015): (a) above 1000 EPG, (b) above 2000 EPG. The risk shown in colour ranging from 0 (green) to 1 (red). Small red circles indicate disease prevalence locations. Haemonchosis R_0 values on risk prediction map district wise (2002–2015): c) above 1000 EPG, d) above 2000 EPG. The risk shown in colour ranging from 0 (green) to 1 (red).

K.P. Suresh et al. Acta Tropica 233 (2022) 106542



Parasitism induces changes in animal behaviour





Treatment AC AP RC

a) Post-Infection Arousal and Valence

b) Post-Infection Valence and Aggression

M.C. Reeves et al.

Applied Animal Behaviour Science 276 (2024) 106323