

aWISH Final Event

EAAP 2026

10 September 2026

CCH – Congress Center, Hamburg | Room Y3

Session 79

Advancing Animal Welfare Assessment
with PLF Technologies (Part 1) | 08:30 CEST

Session 94

Advancing Animal Welfare Assessment
with PLF Technologies (Part 2) | 14:15 CEST



In-person & Online
Registrations



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WELCOME !



ILVO



vetmeduni



Today's programme

- 2 EAAP sessions (morning & afternoon)
- Combination of:
 - aWISH presentations
 - Invited speakers
 - Related research



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Registrations



aWISH



aWISH

ANIMAL WELFARE INDICATORS AT
THE SLAUGHTERHOUSE

awish-project.eu

awish@ilvo.vlaanderen.be

The aWISH vision:

**Improving welfare of pigs and
chickens by automated
monitoring of animal welfare
indicators at slaughter**

*N. Van Noten, F. Tuytens, aWISH consortium,
J. Maselyne*

EAAP conference, Hamburg, 2026
Session 79

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Project call (Horizon Europe 2021)

Research and Innovation to help **policy makers** and other actors (e.g. economic operators)
monitor and improve animal welfare



Large scale



Cost efficient



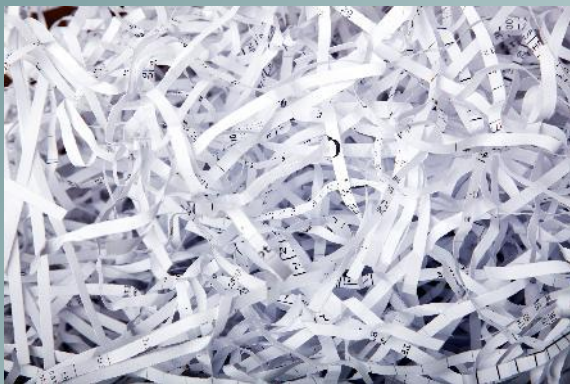
Valid and effective

State of play

Large **volume and variety** of
regional, national, private and public animal welfare improving initiatives



Hard to identify,
only known to insiders



Structural lack of data
before and after
No detail, relevance or reliability
Not accessible for analysis

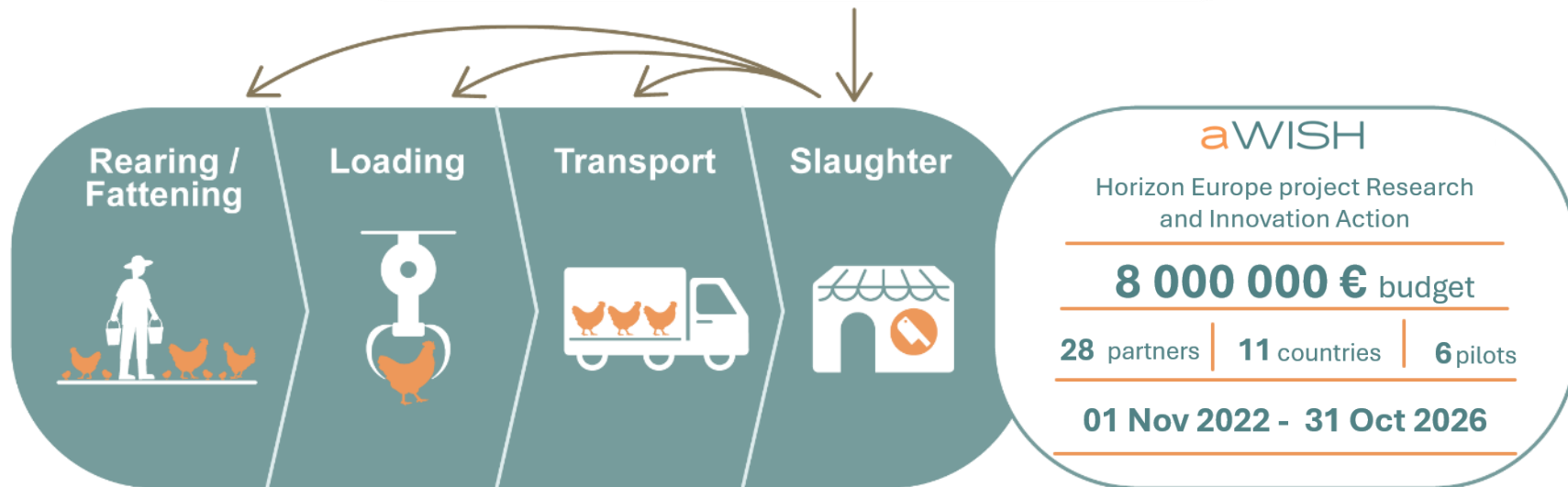


Flying blind
Unknown impact

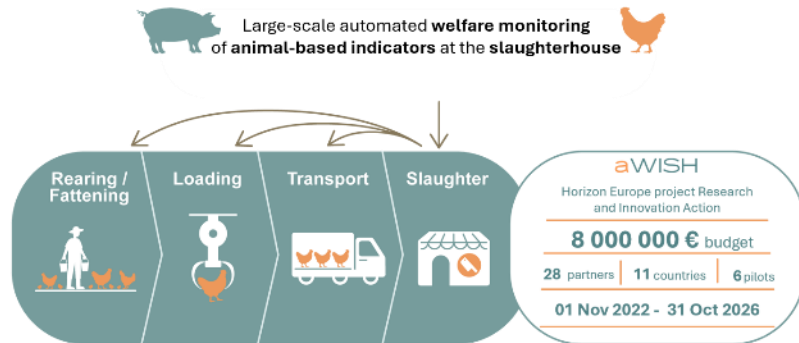
The aWISH vision



Large-scale automated **welfare monitoring**
of **animal-based indicators** at the **slaughterhouse**



The aWISH vision



Why at the slaughterhouse?

Central location

- Large amount of data
- Large number of animals
- Biosecurity

Completing with

- Routine data
- Measurements on-farm
- Measurements during transport

Why broilers and pigs?

Large scale

- Most numerous species in EU
- High welfare problems

Short rearing period

- Limited monitoring time
- Many same age
- Fast corrective actions

Expansion to other species

- 2 types of animals that differ in many aspects



Specific objectives & results

Animal Welfare Indicator Catalogue ¹

- Automated AWI
- Routine & existing data sources



Pilots and Technologies ²

- Development new technologies
- Piloting at large scale



aWISH Data Platform ³

- Feedback
- Benchmarking



AW Assessment and Improvement ⁴

- Intervention studies
- Risk & success factors



Best Practice Guides ⁵



Impact Assessment ⁶

- Socio-economic
- Environment



Stakeholder Engagement and Overall Impact Assessment ⁷



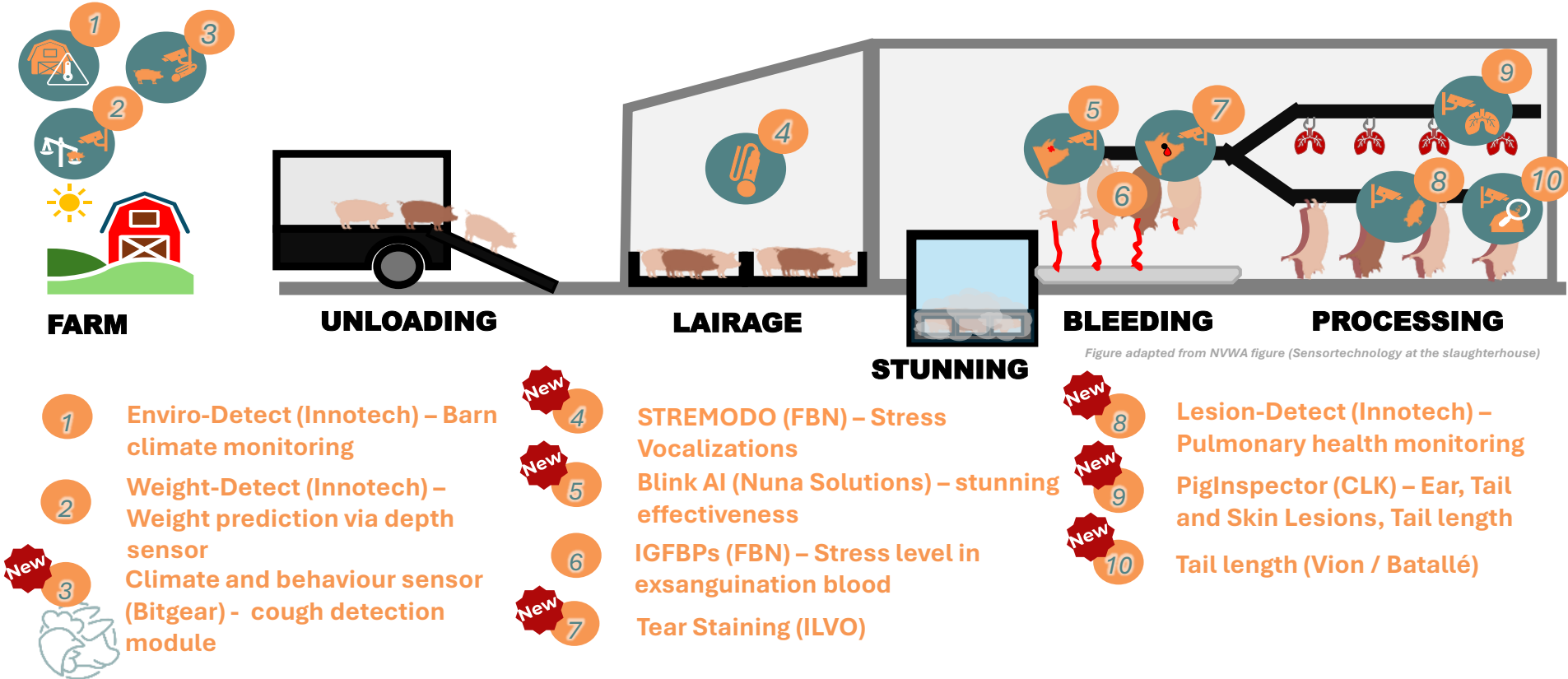
The aWISH pilots

Pilot No.	Pilot Lead	Scientific Lead	Phase
Pilot 1	VION	UU	1st phase
Pilot 2	Batallé	UAB	1st phase
Pilot 3	Plukon - Duc	ITAVI	1st phase
Pilot 4	Plukon - Sieradz	IGBZ PAN	1st phase
Pilot 5	Großfurtner - Higelsberger	Vetmeduni	2nd phase
Pilot 6	Carney	BioSense	2nd phase

16 new technologies
25 new installations



Sensor technologies – Pig pilots



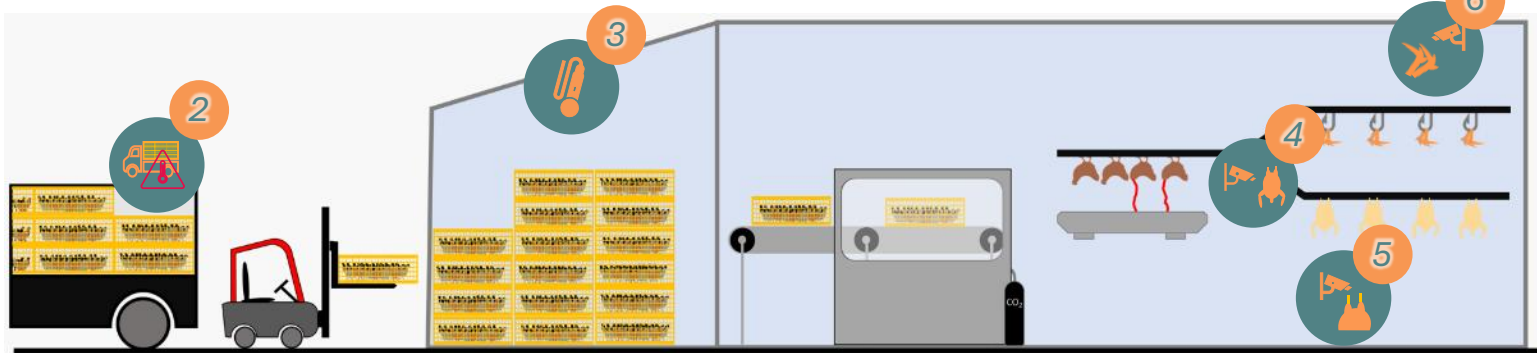
Sensor technologies –Broiler pilots



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FARM



UNLOADING

LAIRAGE

STUNNING

BLEEDING

PROCESSING

Figure adapted from NVWA figure (Sensortechnology at the slaughterhouse)

New

1

EBroilerTrack Image (ITAVI) – Individual broiler activity on farm

New

2

Transport monitoring (ITAVI) – model for heat stress

New

3

EBroilerTrack Sound (ITAVI) – Broiler vocalizations

New

4

ChickenCheck Catch Damage (CLK) – Catching damage (bruises and fractures) and scratches

5

ChickenCheck Hockburn (CLK) –Hockburns

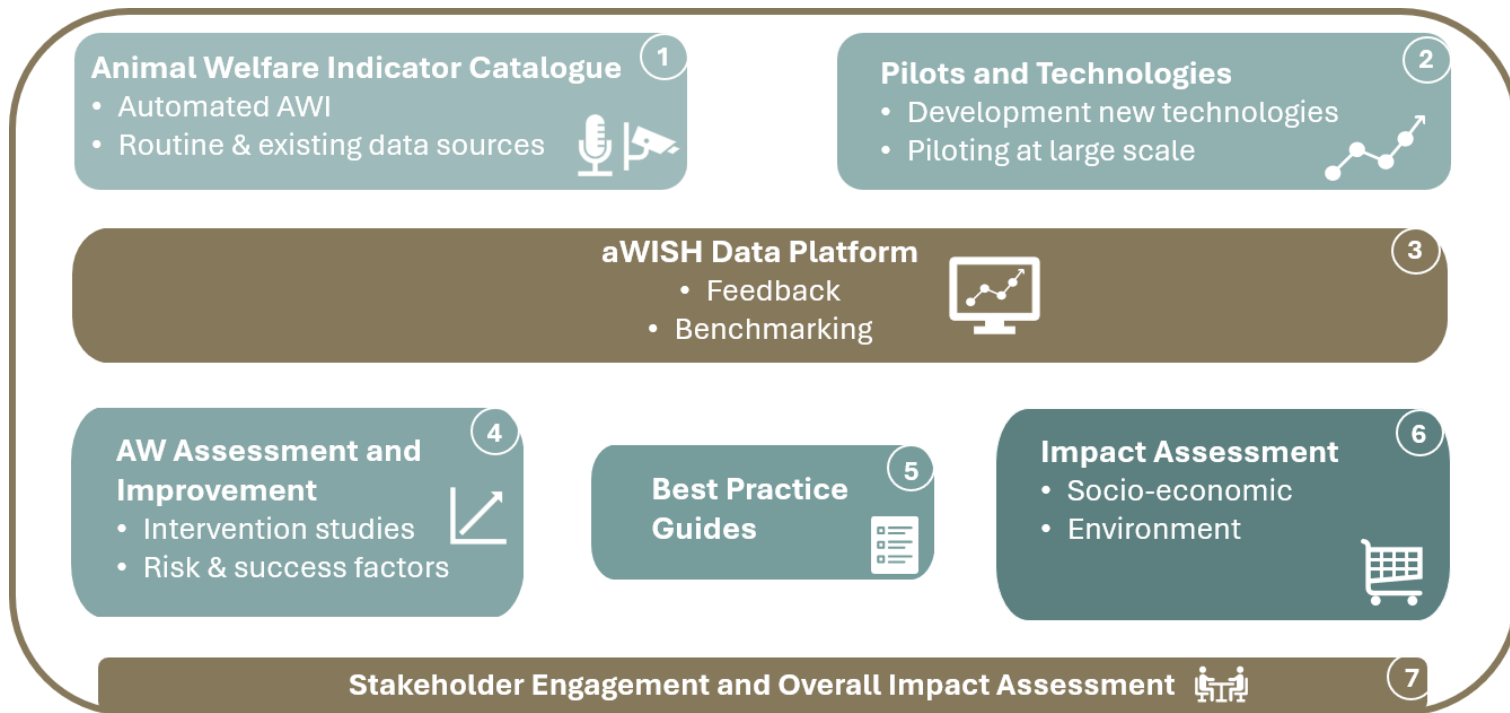
6

ChickenCheck Footpad (CLK) –Footpad dermatitis



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Results



These results will be shared with you
through the scientific programme of today

SAVE THE DATE

aWISH MEAT INDUSTRY EVENT



The Future of Animal Welfare Monitoring in the Meat Supply Chain

Explore how animal welfare monitoring can support decision-making and create value across the meat supply chain.



DATE

08.10.2026



TIME

10:00 - 13:00 CET



FORMAT

Online | Zoom

REGISTRATION DETAILS COMING SOON

You are also kindly invited for our online event on 8th October



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Thank you!

noemie.vannoten@ilvo.vlaanderen.be



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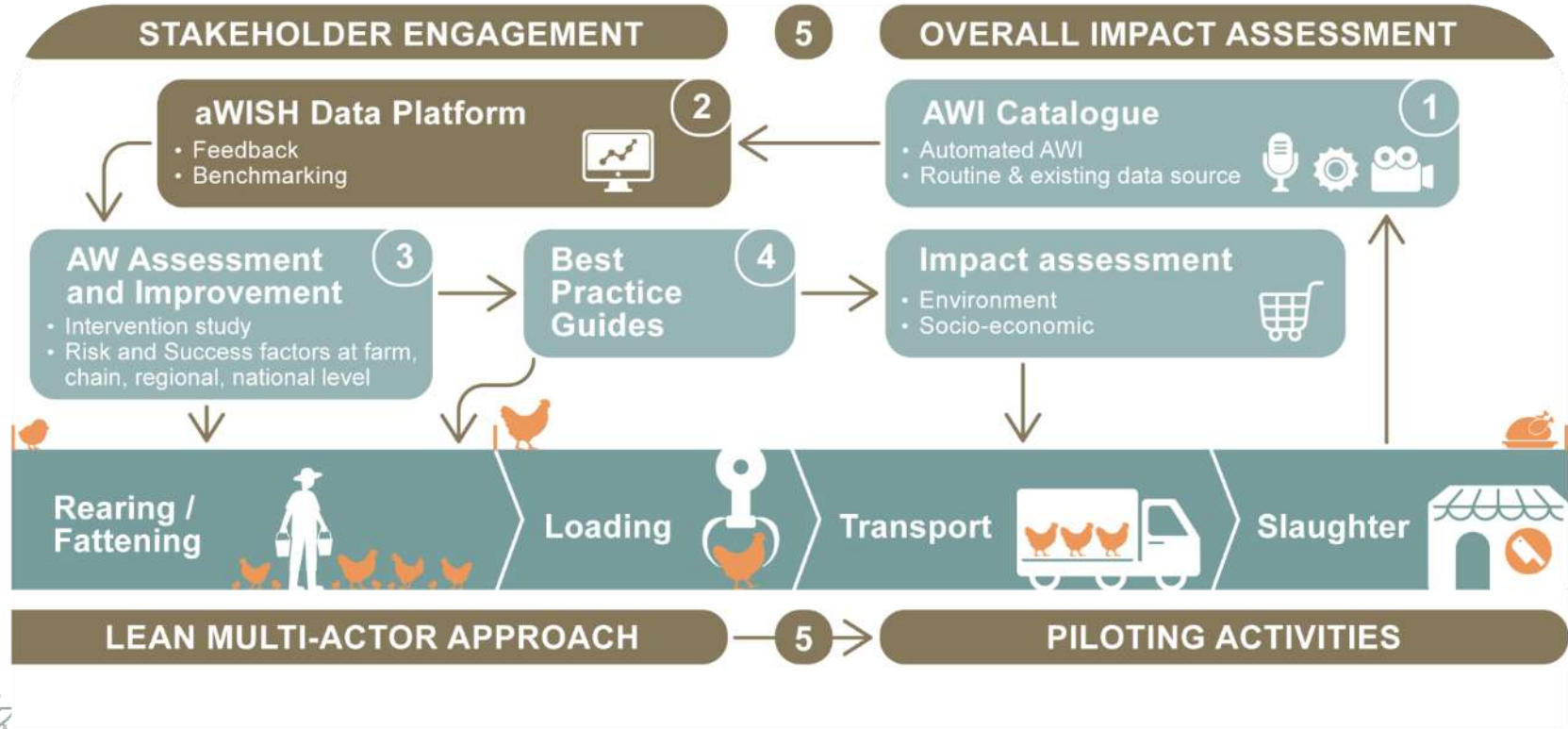
An Integrated Welfare Intelligence Platform Across the Animal Production Chain

Konstantinos Perakis, UBITECH

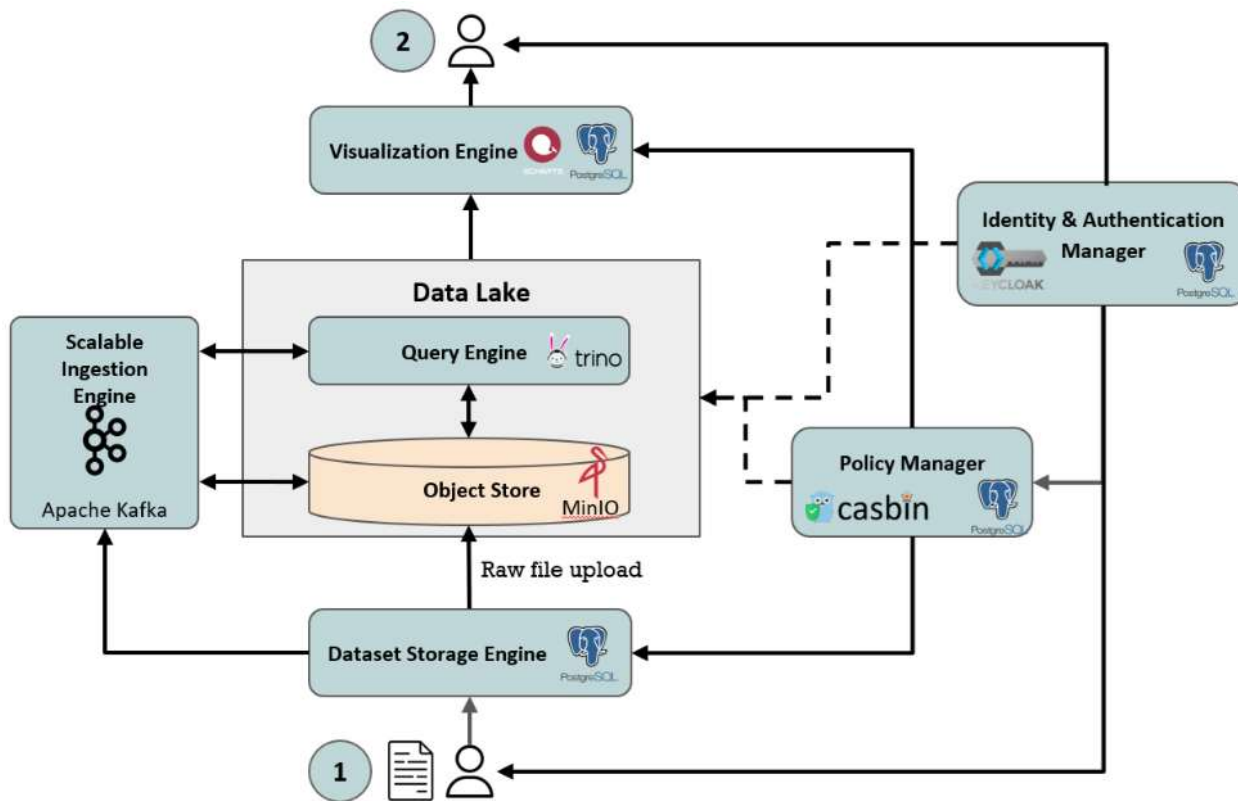


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The Fragmented Data Challenge



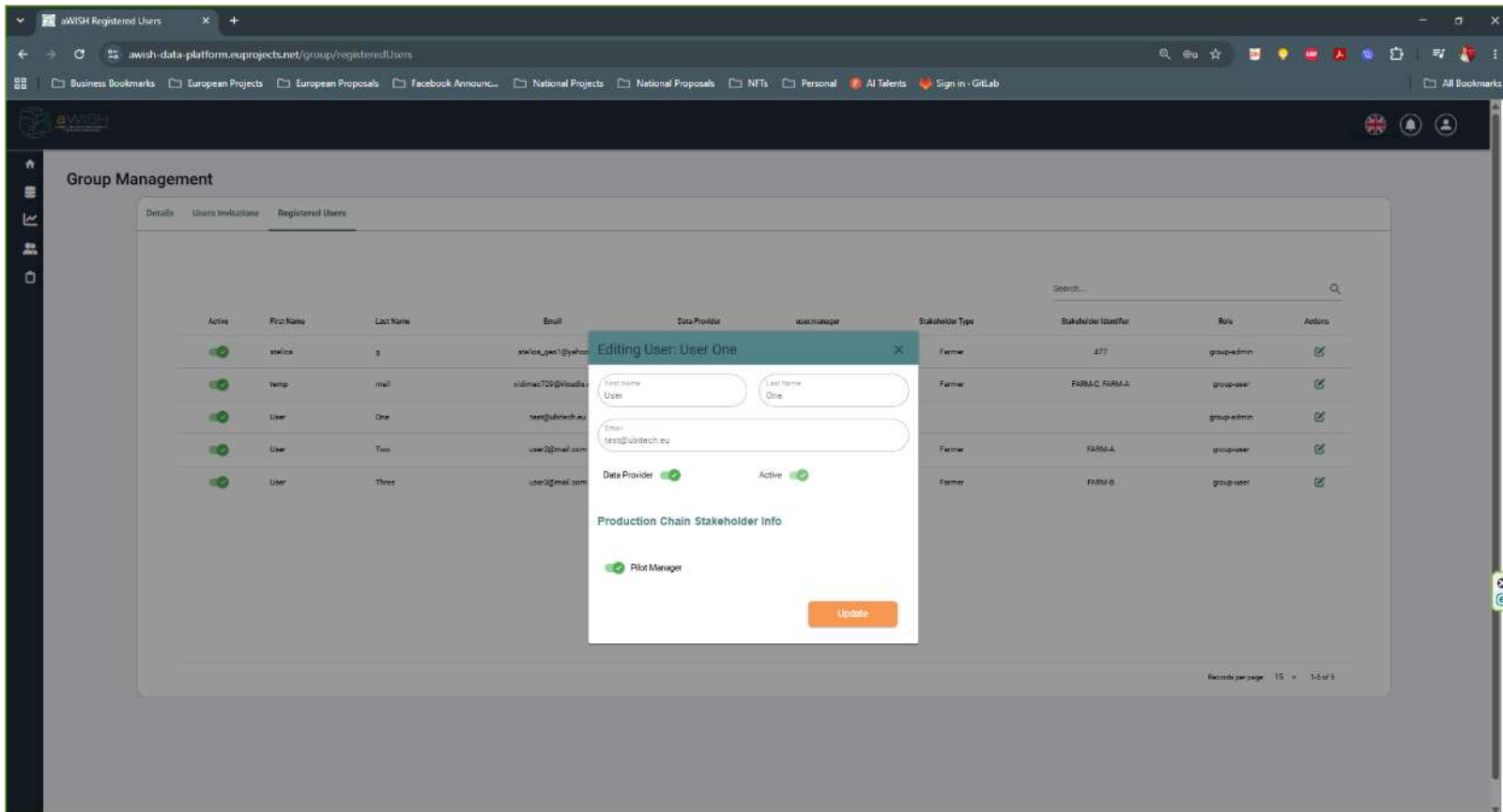
The aWISH Integrated Data Platform



The aWISH Integrated Data Platform



The aWISH Integrated Data Platform



Group Management

Details Users Invitations Registered Users

Search...

Active	First Name	Last Name	Email	Data Provider	Role	Stakeholder Type	Stakeholder Identifier	Actions
	etelica	g	etelica_gast@yahoo		group-admin	Farmer	477	
	temu	mail	sidmae729@cloudi		group-user	Farmer	FARM-C, FARM-A	
	User	One	test@ubitech.eu		group-admin	Farmer	FARM-A	
	User	Two	user2@gmail.com		group-user	Farmer	FARM-A	
	User	Three	user3@gmail.com		group-user	Farmer	FARM-B	

Editing User: User One

First Name: User Last Name: One

Email: test@ubitech.eu

Data Provider: Active:

Production Chain Stakeholder Info

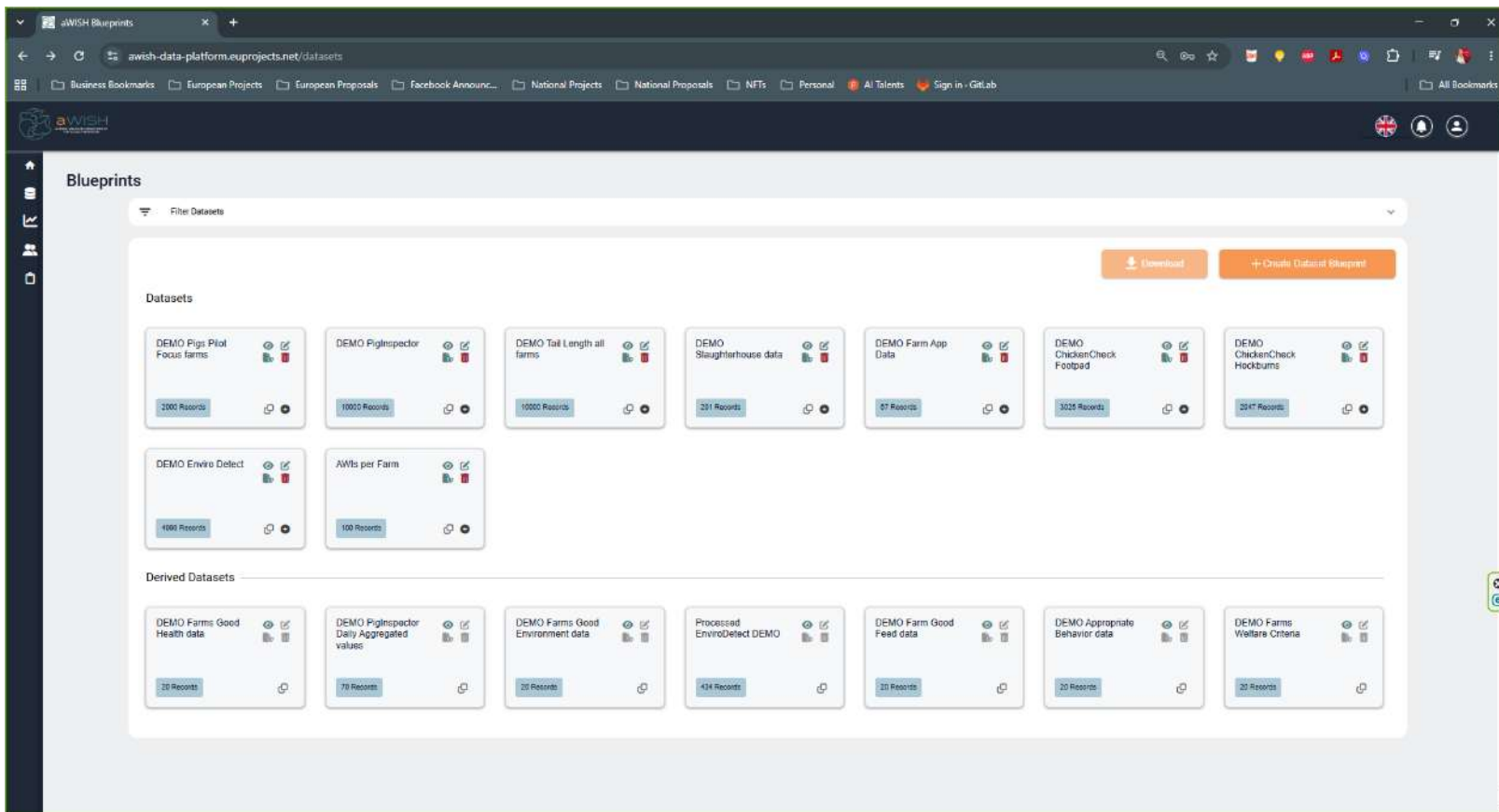
Pilot Manager

Update

Records per page: 15 1-5 of 5



The aWISH Integrated Data Platform

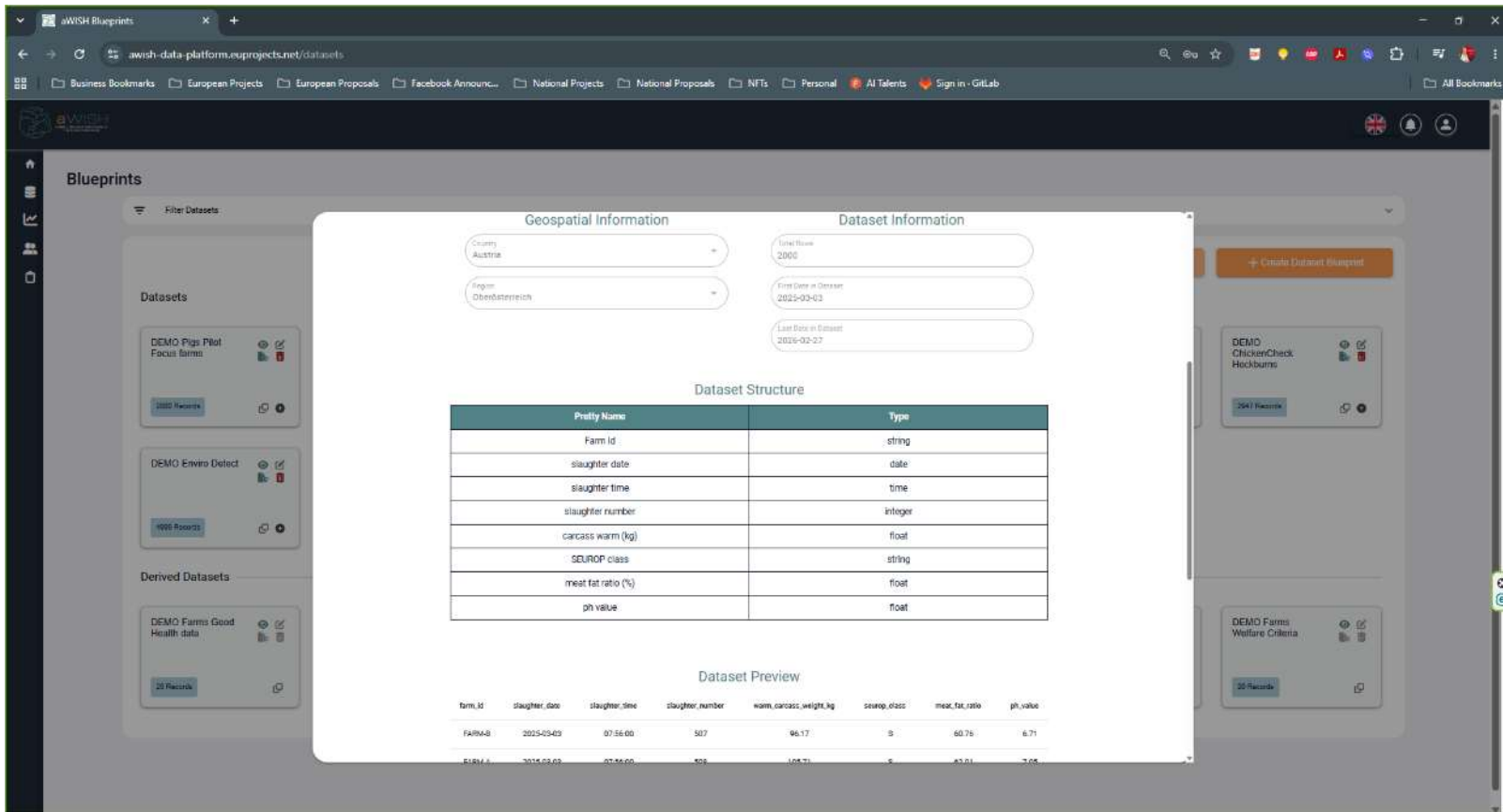


The screenshot displays the 'aWISH Blueprints' web application. The browser address bar shows 'awish-data-platform.eu/projects.net/datasets'. The page features a dark sidebar on the left with navigation icons. The main content area is titled 'Blueprints' and includes a 'Filter Datasets' dropdown. At the top right of the main area are two orange buttons: 'Download' and '+ Create Dataset Blueprint'. The data is organized into two sections: 'Datasets' and 'Derived Datasets'. Each dataset is represented by a card showing its name, a record count, and icons for visualization and export.

Dataset Name	Record Count
DEMO Pigs Pilot Focus farms	1000 Records
DEMO PigsInspector	10000 Records
DEMO Tail Length all farms	10000 Records
DEMO Slaughterhouse data	201 Records
DEMO Farm App Data	67 Records
DEMO ChickenCheck Footpad	3028 Records
DEMO ChickenCheck Hookburns	2547 Records
DEMO Enviro Detect	1000 Records
AWIs per Farm	100 Records
DEMO Farms Good Health data	20 Records
DEMO PigsInspector Daily Aggregated values	70 Records
DEMO Farms Good Environment data	20 Records
Processed EnviroDetect DEMO	434 Records
DEMO Farm Good Feed data	20 Records
DEMO Appropriate Behavior data	20 Records
DEMO Farms Welfare Criteria	20 Records



The aWISH Integrated Data Platform



The screenshot displays the aWISH Integrated Data Platform interface. A modal window is open, allowing users to filter datasets based on Geospatial Information and Dataset Information. The Geospatial Information section includes fields for Country (Austria) and Region (Oberösterreich). The Dataset Information section includes fields for Total Rows (2000), First Date in Dataset (2022-03-03), and Last Date in Dataset (2026-02-27). Below these fields is a table titled "Dataset Structure" showing the schema of the dataset. The table has two columns: "Pretty Name" and "Type". The rows are: Farm Id (string), slaughter date (date), slaughter time (time), slaughter number (integer), carcass weight (kg) (float), SEUROP class (string), meat fat ratio (%) (float), and ph value (float). Below the table is a "Dataset Preview" section showing a sample of the data. The preview table has columns: farm_id, slaughter_date, slaughter_time, slaughter_number, weight_carcass_kg, seurop_class, meat_fat_ratio, and ph_value. The first row shows data for FARM-8, and the second row shows data for FARM-9.

Geospatial Information

Country: Austria

Region: Oberösterreich

Dataset Information

Total Rows: 2000

First Date in Dataset: 2022-03-03

Last Date in Dataset: 2026-02-27

Dataset Structure

Pretty Name	Type
Farm Id	string
slaughter date	date
slaughter time	time
slaughter number	integer
carcass weight (kg)	float
SEUROP class	string
meat fat ratio (%)	float
ph value	float

Dataset Preview

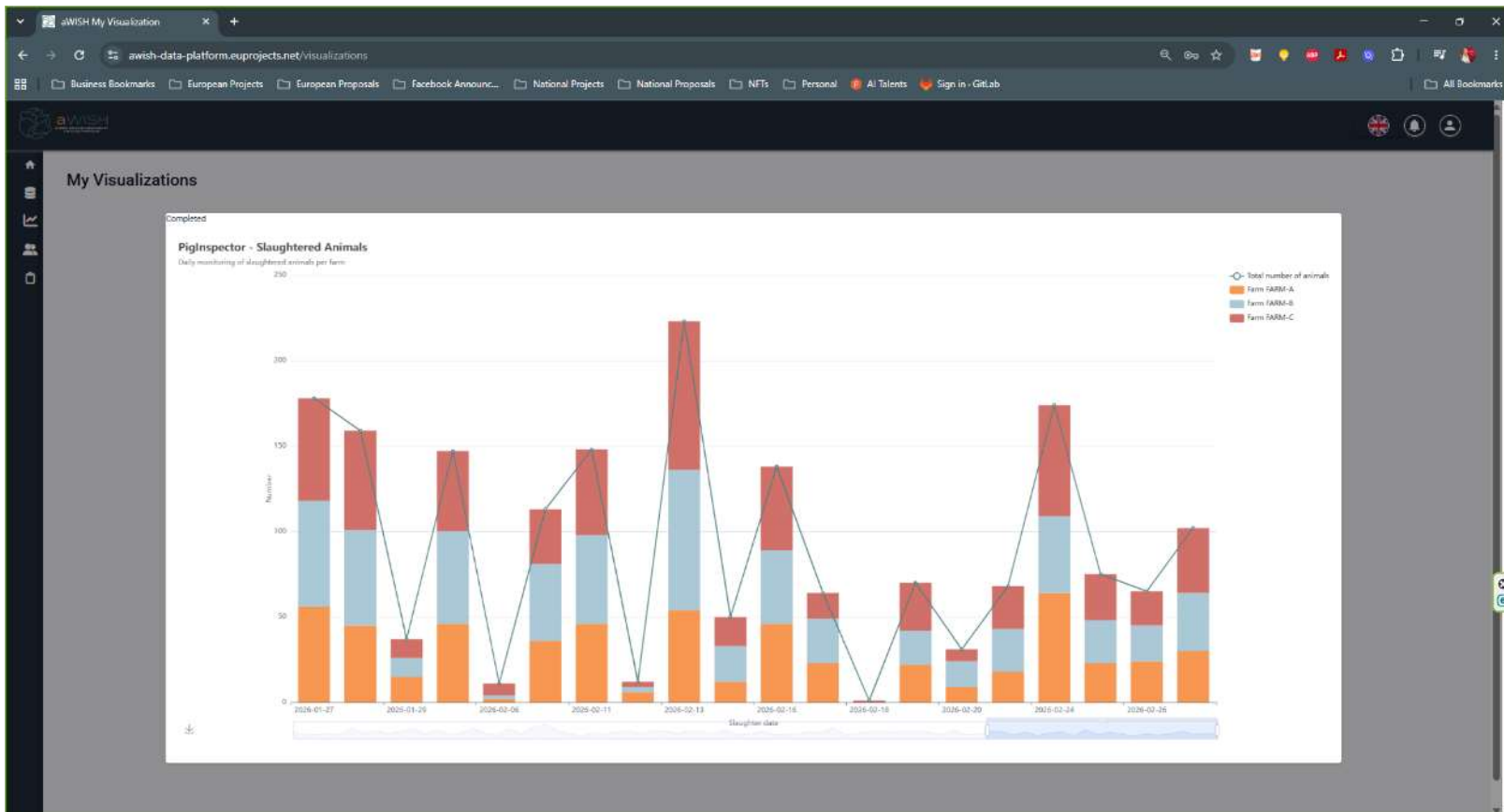
farm_id	slaughter_date	slaughter_time	slaughter_number	weight_carcass_kg	seurop_class	meat_fat_ratio	ph_value
FARM-8	2025-03-03	07:56:00	507	96.17	S	60.76	6.71
FARM-9	2025-03-03	07:56:00	508	108.71	S	62.01	7.08



The aWISH Integrated Data Platform

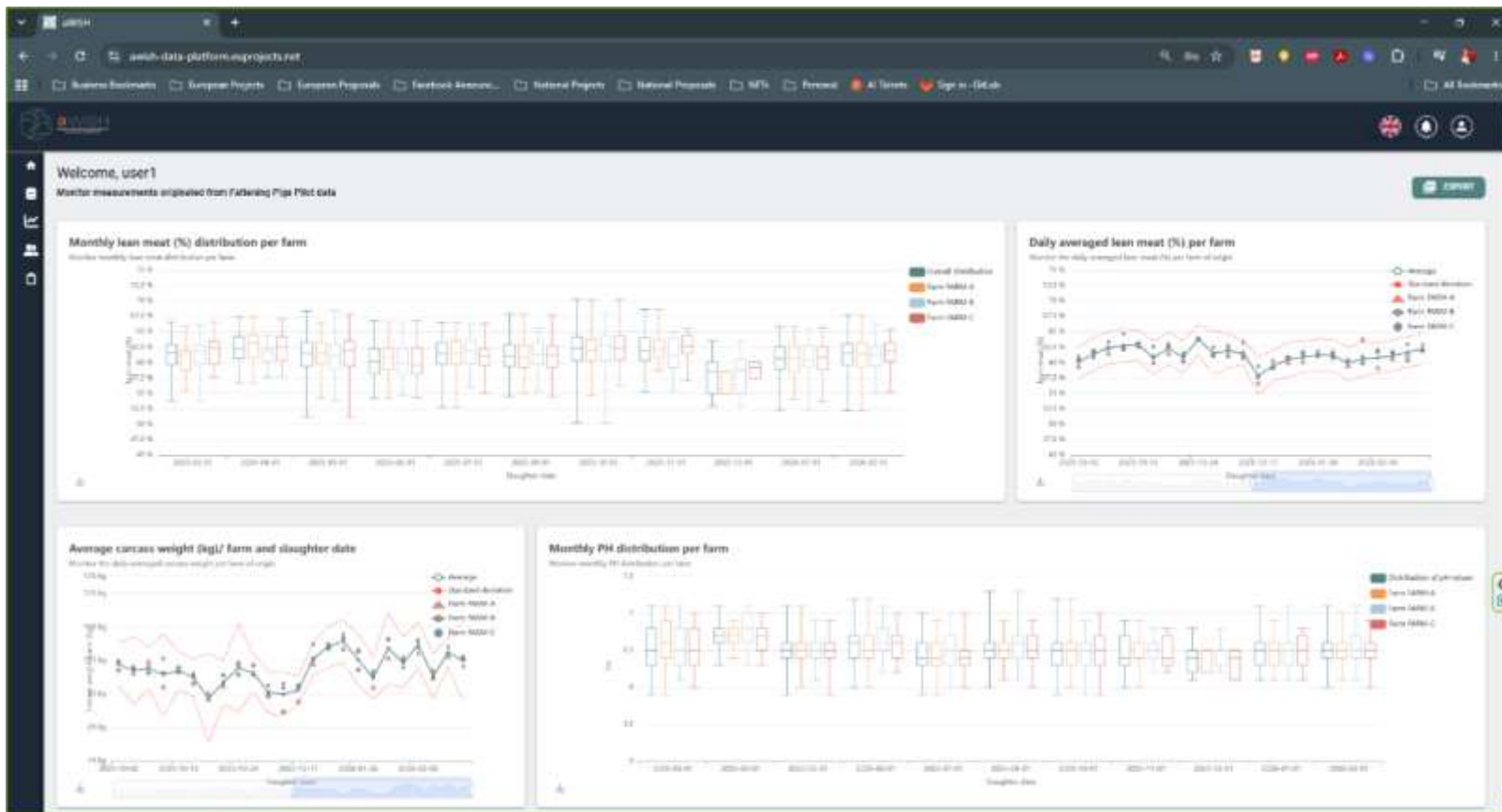


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The aWISH Integrated Data Platform



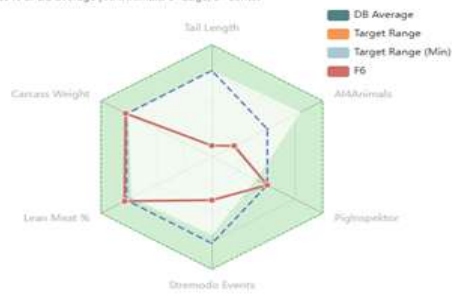
The aWISH Integrated Data Platform

< Farmer test
Test

EXPORT

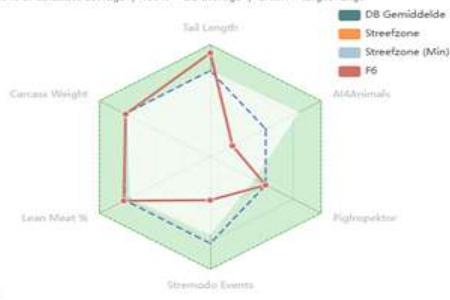
Batch KPI Radar – Latest Delivery (Pilot 1)

KPIs as % of DB average | AI4Animals: 0=Edge, 5=Center



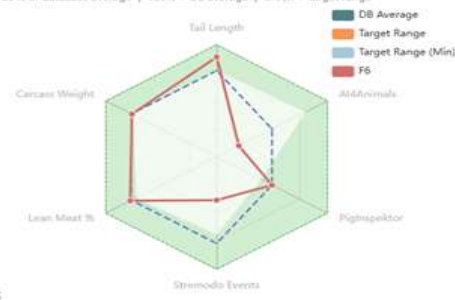
Pilot 1 - Batch KPI Radar 1 Deliveries Ago

KPIs as % of database average | 100% = DB average | Green = target range



Batch KPI Radar – 2 Deliveries Ago (Pilot 1)

KPIs as % of database average | 100% = DB average | Green = target range



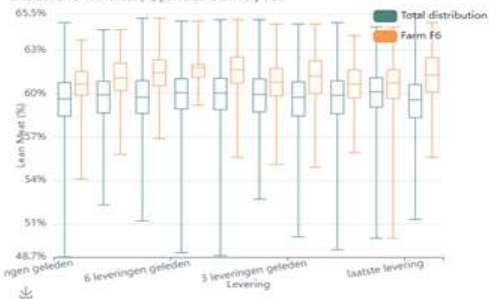
Carcass weight distribution per farm (Pilot 1)

Monthly carcass weight distribution per farm



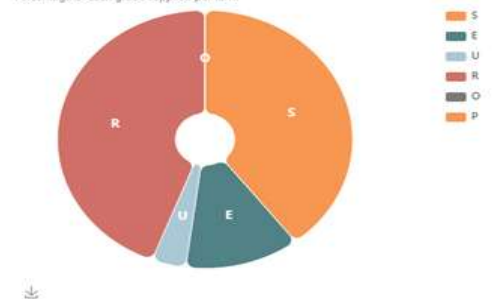
Lean Meat % per Delivery (Pilot 1)

Distribution of lean meat (%) per relative delivery slot

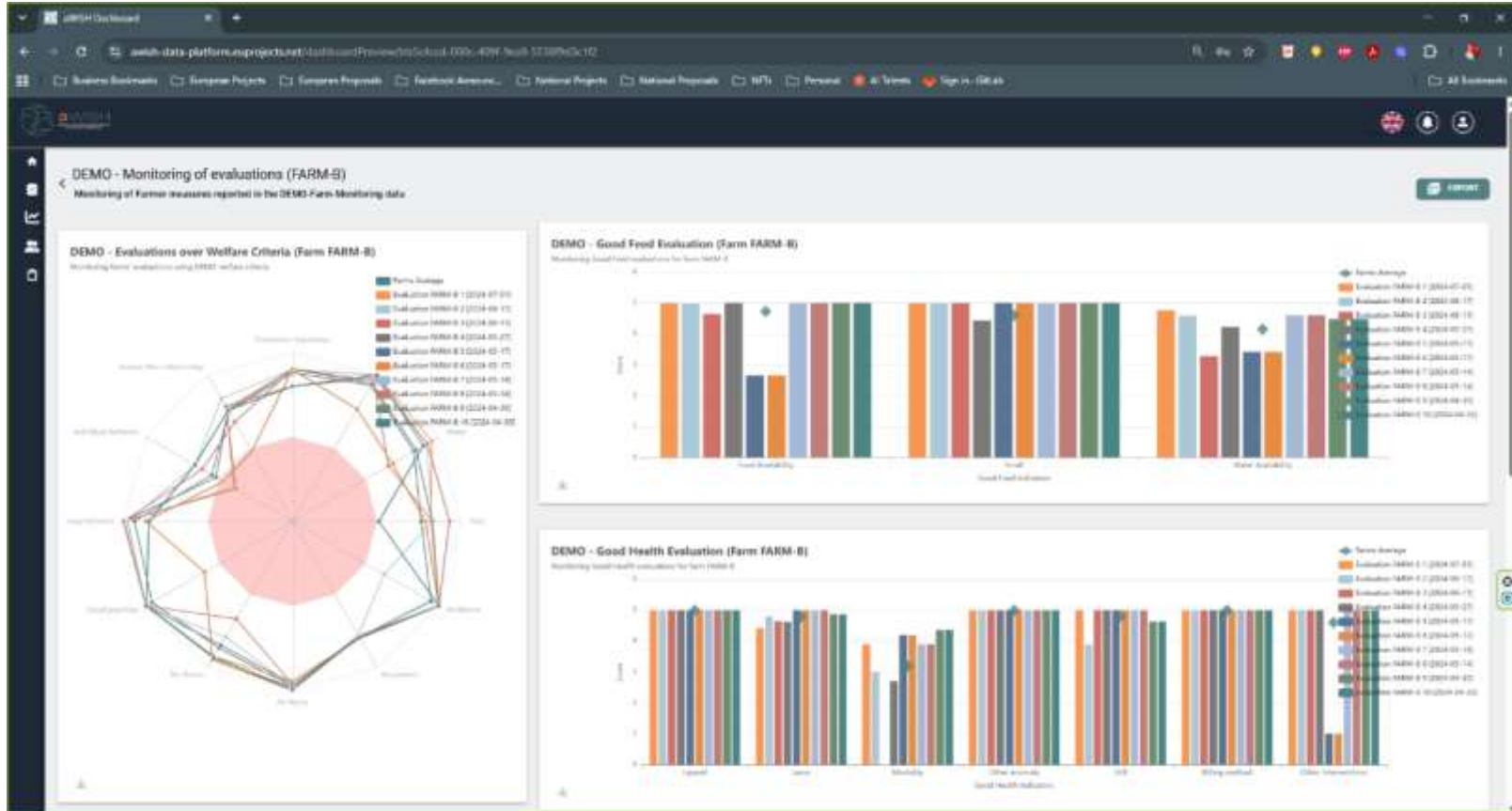


Contribution to SEUROP Quality Classes by Farm (Pilot 1)

Percentage of each grade supplied per farm



The aWISH Integrated Data Platform



The aWISH Integrated Data Platform

Policy Editor

Resource Name: API to get Pops
Resource Type: E474207
Resource ID: 207642249a-4ed3-4d8b-ba01-1d171d3

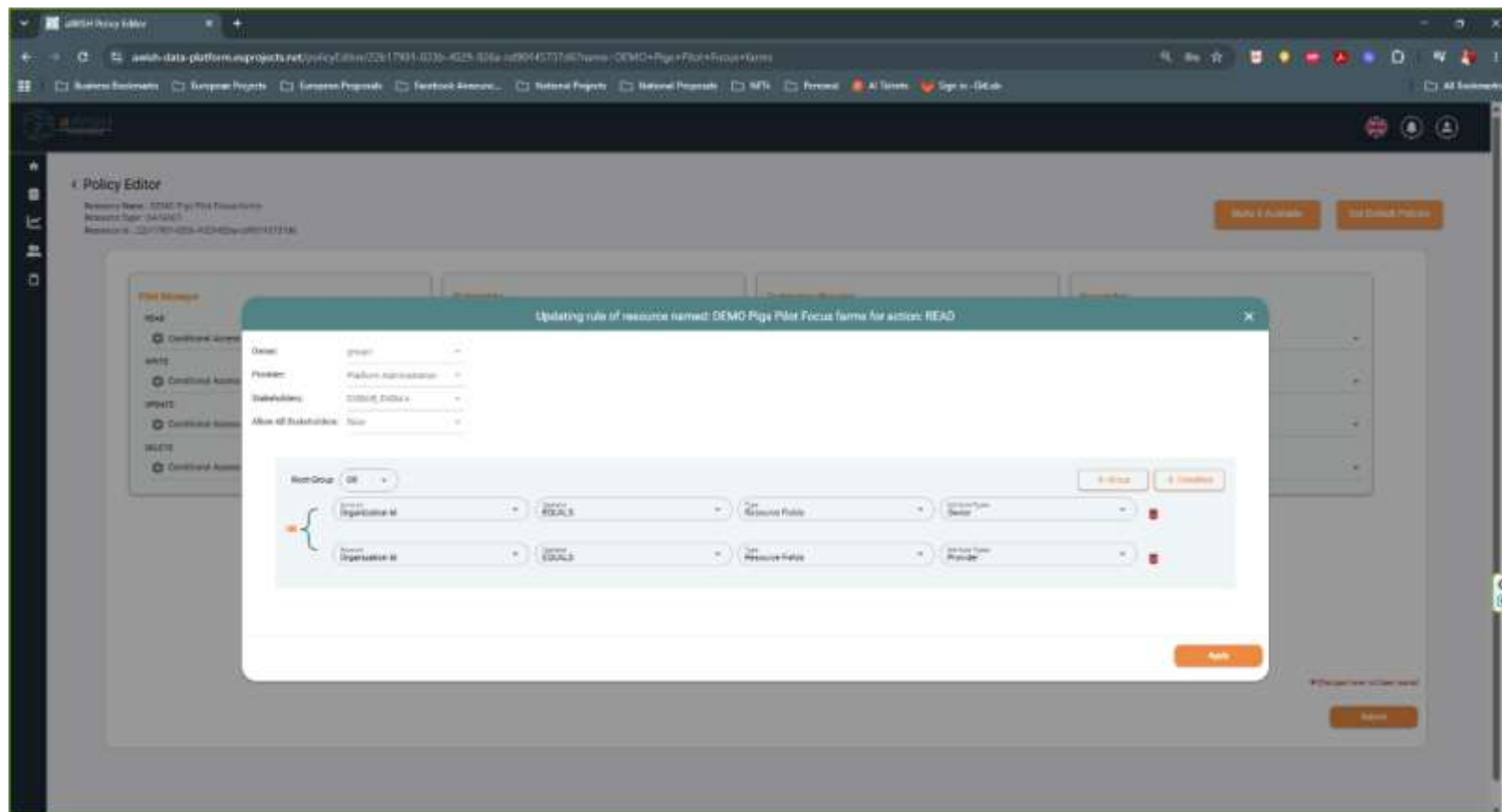
Make it Available Not Confirmed Function

Field Manager	Collection	Technology Provider	Resource
READ Conditional Access	READ Conditional Access	READ Conditional Access	READ Access
WRITE Conditional Access	WRITE Conditional Access	WRITE Conditional Access	WRITE Access
UPDATE Conditional Access	UPDATE No Access	UPDATE Conditional Access	UPDATE Conditional Access
DELETE Conditional Access	DELETE No Access	DELETE Conditional Access	DELETE Conditional Access

Save



The aWISH Integrated Data Platform



The aWISH Integrated Data Platform

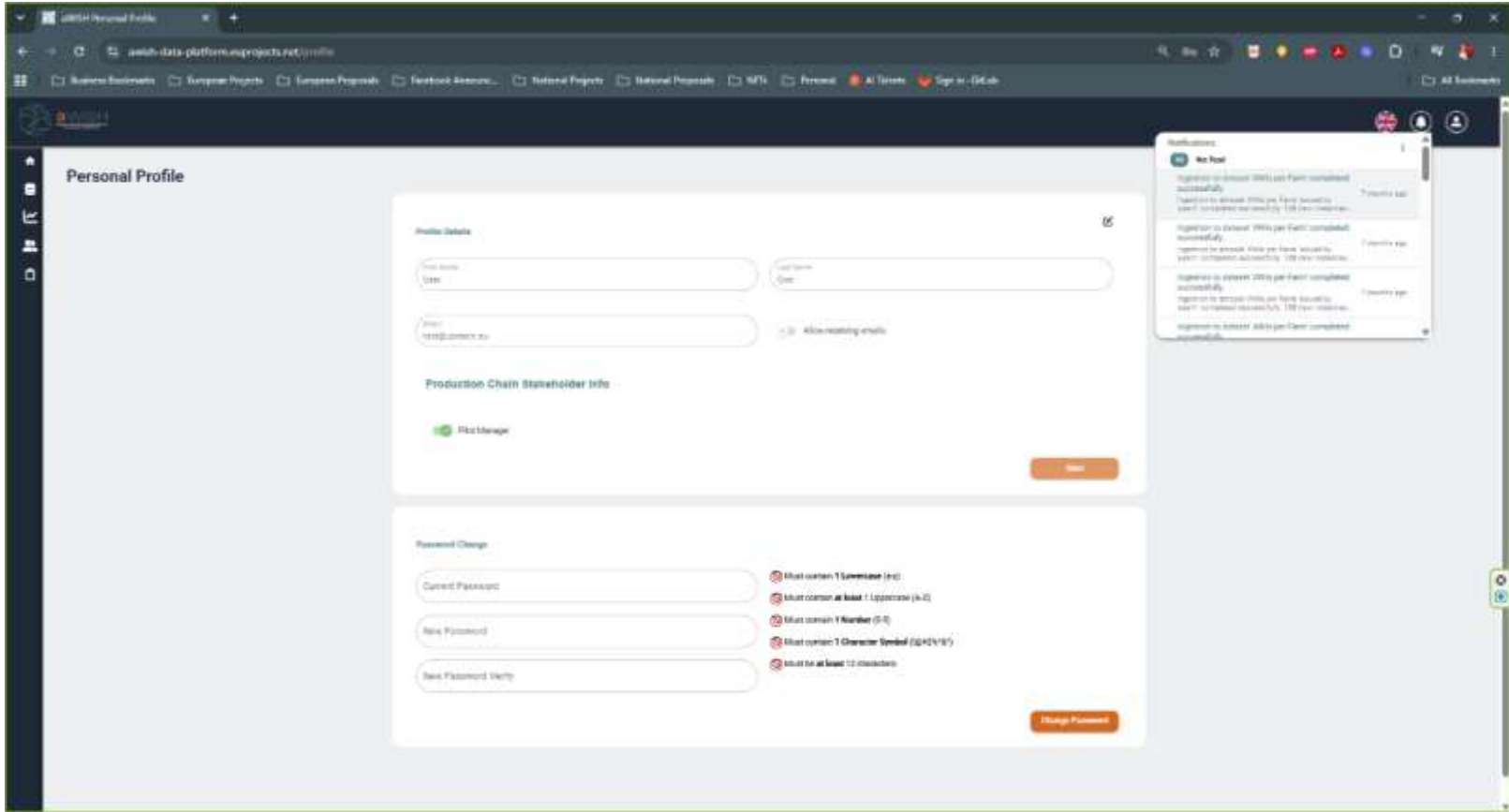


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The aWISH Integrated Data Platform



The aWISH Integrated Data Platform



The screenshot shows the 'Personal Profile' page of the aWISH Integrated Data Platform. The page is divided into several sections:

- Profile Details:** Contains input fields for 'First Name', 'Last Name', 'Email', and 'Phone'. There is a checkbox for 'Allow marketing emails'.
- Production Chain Stakeholder Info:** Includes a 'Risk Manager' section with a green checkmark and a 'Save' button.
- Reset Password:** Contains input fields for 'Current Password', 'New Password', and 'New Password Verify'. To the right of these fields are five password requirements:
 - Must contain 1 Uppercase (A-Z)
 - Must contain at least 1 Lowercase (a-z)
 - Must contain 1 Number (0-9)
 - Must contain 1 Character Symbol (!@#%^&*)
 - Must be at least 12 charactersA 'Change Password' button is located at the bottom right of this section.

A notification pop-up is visible on the right side of the page, titled 'No Post', listing several updates with timestamps like '7 months ago'.

The aWISH Integrated Data Platform

aWISH Project available at:
<https://www.awish-project.eu/>



aWISH Data Platform available at:
<https://awish-data-platform.euprojects.net/signin>

aWISH Data Platform Video available at:
<https://www.youtube.com/watch?v=o270HtDj9Dk>

(Data) Pain Points



Thank you!





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awish-project.eu

awish@ilvo.vlaanderen.be

***Experiences and expectations of
pig processing plants in the
aWISH project to monitor animal
welfare using sensor technologies***

R.E. Klont, M. Bouwknecht, E. Kurt N. Kajari, J. Reixach, C. Pfeiffer,
M. Lindinger



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Why slaughterhouses are an interesting actor

A high-throughput observation point where information from the production chain converges

Overall aim

To develop an automated monitoring of animal-based welfare indicators across the entire pork production chain, with special focus on the pig processing plant.

Goal

Help slaughterhouses optimise animal welfare, transparency and product quality by digitally capturing key indicators

Focus today

Experiences from four European slaughterhouses.

Which technologies included

What worked, what proved difficult, and what is needed for routine implementation.

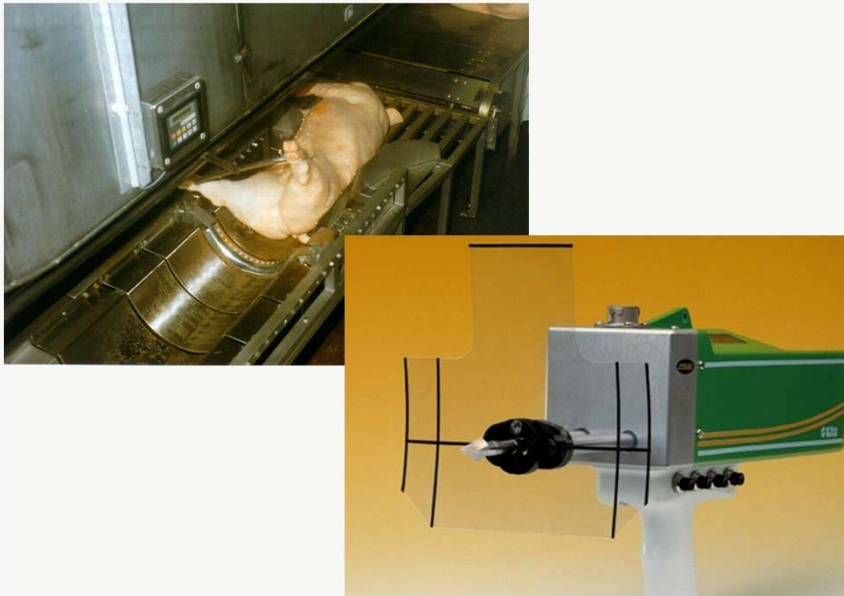




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Methods – Existing Slaughterhouse data collection

- AI4Animals- Unloading after transport



How it works

1 AI solution - detections



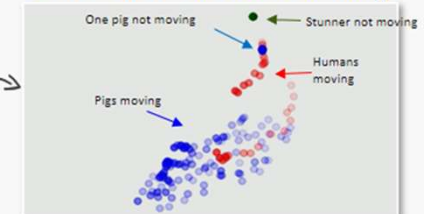
The AI4A algorithm detects animals, people, and objects and how they interact

4 Dashboard - trend reports



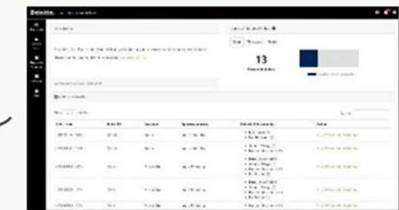
AI4A includes trends reports outlining deviations over time and per slaughterhouse

2 AI solution – movement heatmaps



Images are translated into movement heatmaps to detect potential handling issues

3 Dashboard - deviations list review



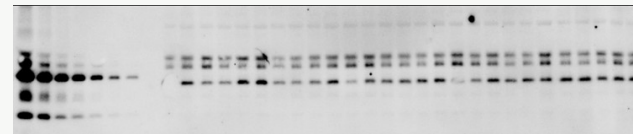
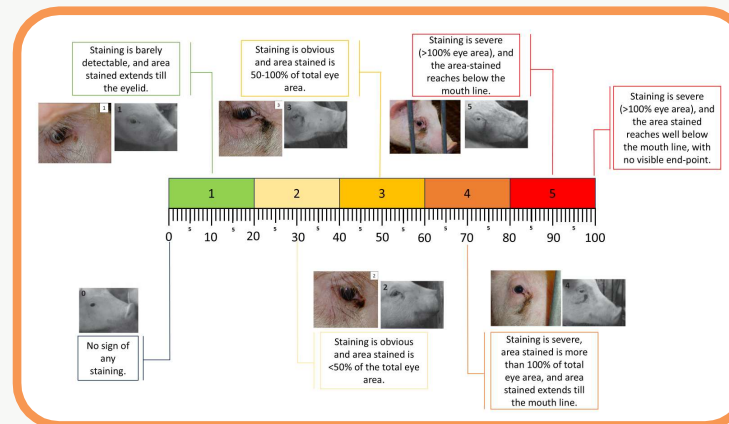
AI4A selects and aggregates all video recordings containing potential deviations to be reviewed

- Ultrasound and fibre-optic probes providing real-time carcass composition data
- Veterinary inspection data (manual)



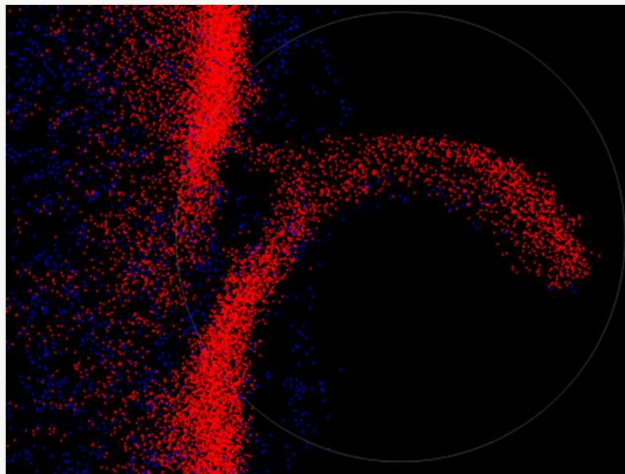
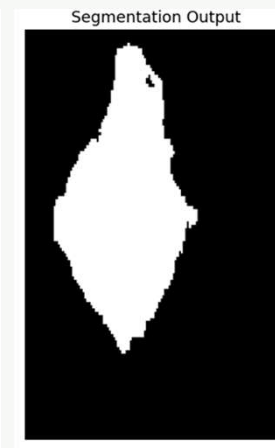
Methods – Tested/Developed sensors and data collection

- Sound and motion sensors piloted as objective welfare indicators
- Stunning effectiveness assessed via automatic image collection and AI algorithms
- Debleeding quality assessed during exsanguination, complemented by lactate and stress-related blood analyses
- Automated tear staining assessment implemented to test and validate this novel welfare indicator



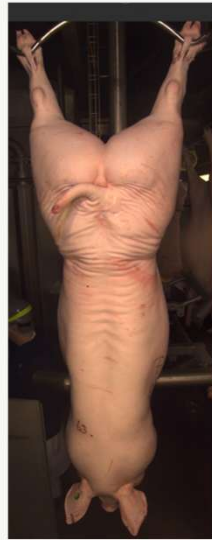
Methods – Tested/Developed sensors and data collection

- Inline tail-length measurement with automatic tail damage detection, fed back to farmers via an online data platform
- Automated image analysis for identifying and scoring gross lung lesions linked to respiratory disease



Methods – Tested/Developed sensors and data collection

- PigInspector: whole carcass image analysis, including tail length and lesions



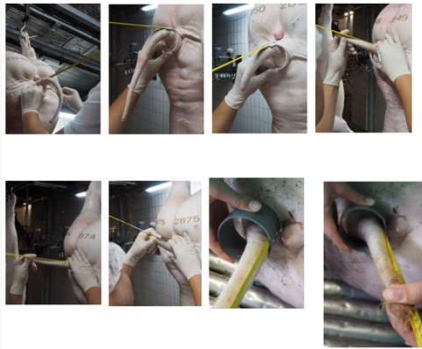
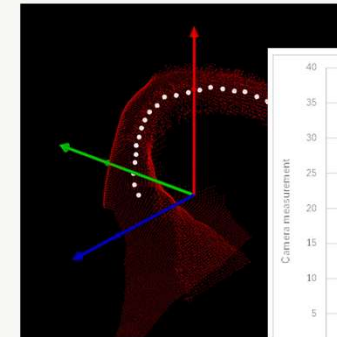
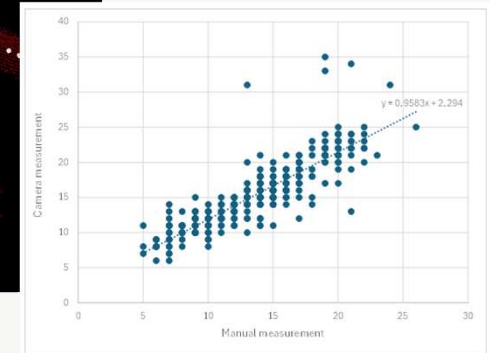
- All systems evaluated for technical robustness, integration capacity, operational feasibility and usefulness for cross-chain welfare monitoring



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Results and Observations

Findings highlight the potential of technologies to safeguard and improve animal welfare



SENSOR CAPTURE

Repeated observations



ALGORITHM VALIDATION

Indicator extraction



LINKED DATA

Patterns and prediction

Not all technologies perform equally well on all sites: fit-for-purpose selection

Sensor and AI integration show strong potential for objective, continuous welfare assessment and early detection of welfare risks. Extensive validation and fine tuning needed per site.



What worked, and what was harder than expected?

Commercial deployment revealed both the value and the limits of sensor-based welfare monitoring

WHAT WORKED

- ✓ Objective, repeated data capture
- ✓ Potential for continuous welfare assessment
- ✓ Indicators available at several chain stages
- ✓ Digital feedback opportunities for farmers and plants

HARDER THAN EXPECTED

- ! Site-specific tuning and image conditions
- ! Algorithm training and validation
- ! IT integration and edge-computing capacity
- ! Durability under harsh cleaning conditions
- ! Embedding outputs in operational routines



Five conditions for routine implementation

Successful digital welfare monitoring is an organisational and operational challenge as well as a technical one

1

Management ownership

Plant leadership
and IT
involvement from
the start

2

IT & edge capacity

Reliable
infrastructure for
real-time
processing

3

Local validation & tuning

Time, reference
data and site-
specific
calibration

4

Industrial robustness

Equipment suited
to cleaning and
plant conditions

5

Actionable feedback

Clear users,
decisions and
supply chain
actions



Sensors are only the starting point

Three take-home messages from aWISH slaughterhouse implementation

1

Commercial slaughterhouses can become central welfare-observation points.

2

Technology must be validated, site-adapted and industrially robust.

3

Real impact requires integrated data and feedback across the chain.

CENTRAL LESSON

Successful welfare digitalisation depends as much on implementation, validation and collaboration as it does on the sensor itself.

Thank you



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awish-project.eu

awish@ilvo.vlaanderen.be

Using continuous sensor data on barn climate to evaluate the effect of barn climate advice on pig welfare: a Dutch case- study

*Kenny van Langeveld, Nienke van Staaveren, Noémie Van Noten,
T. Bas Rodenburg, Mona F. Giersberg, Ronald Klont, Kristel
Mulder, Frank A.M. Tuytens*

EAAP 2026 | session 79 | 10-09-2026



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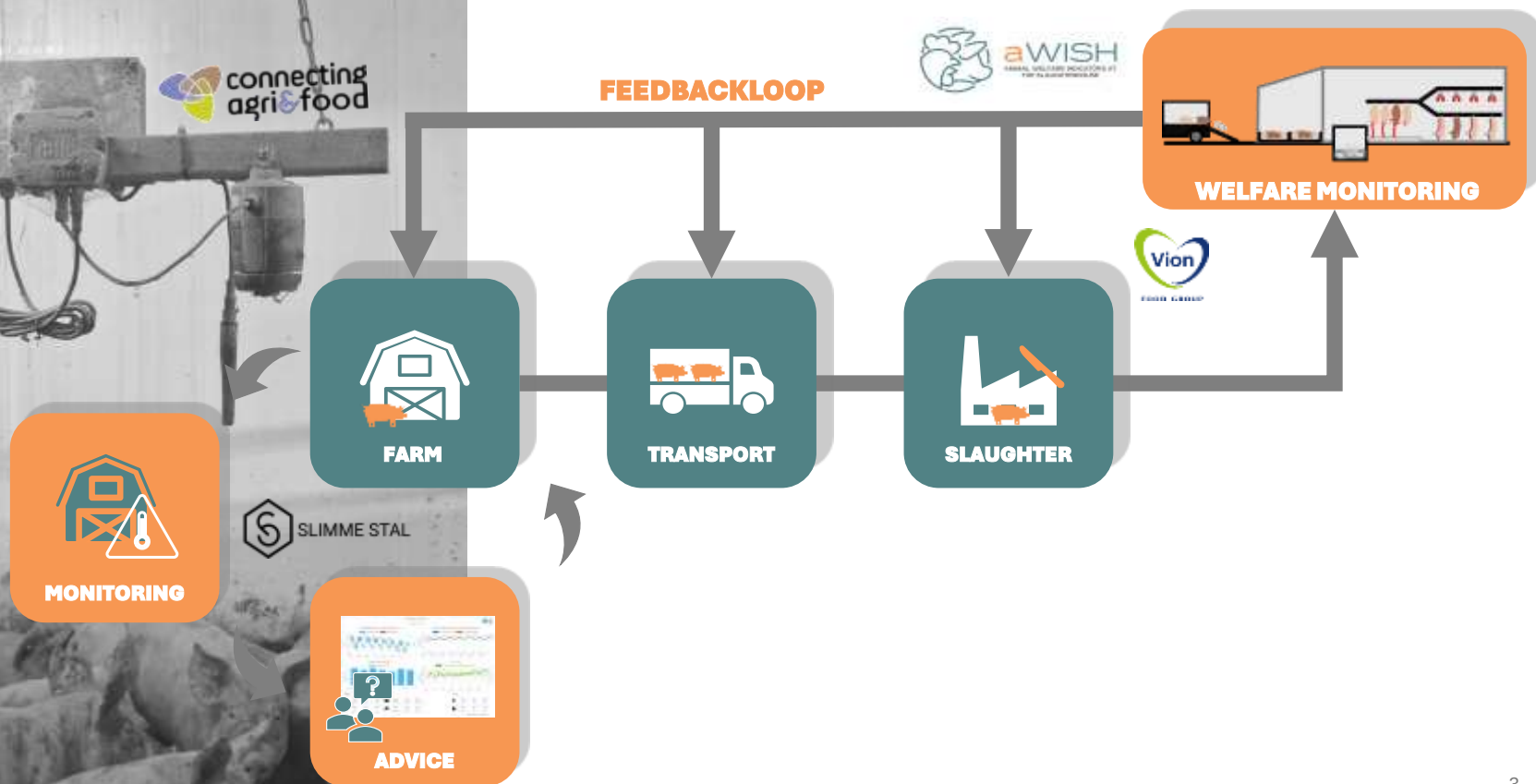
awish@ilvo.vlaanderen.be

BACKGROUND & OBJECTIVE

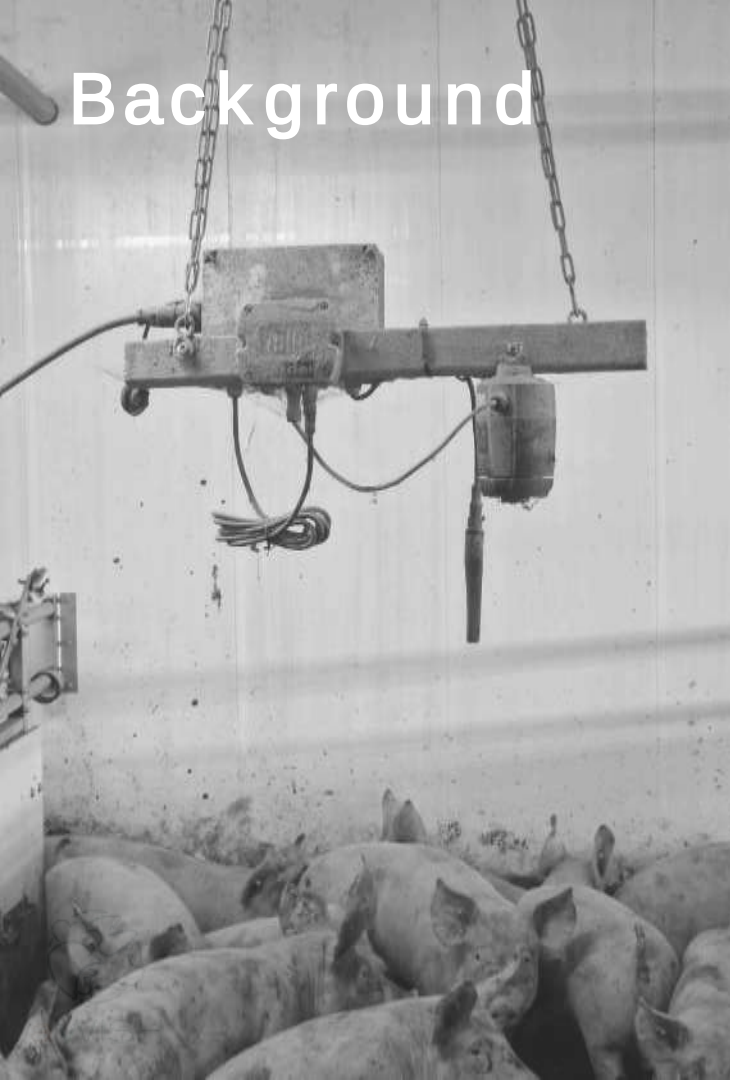


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Background



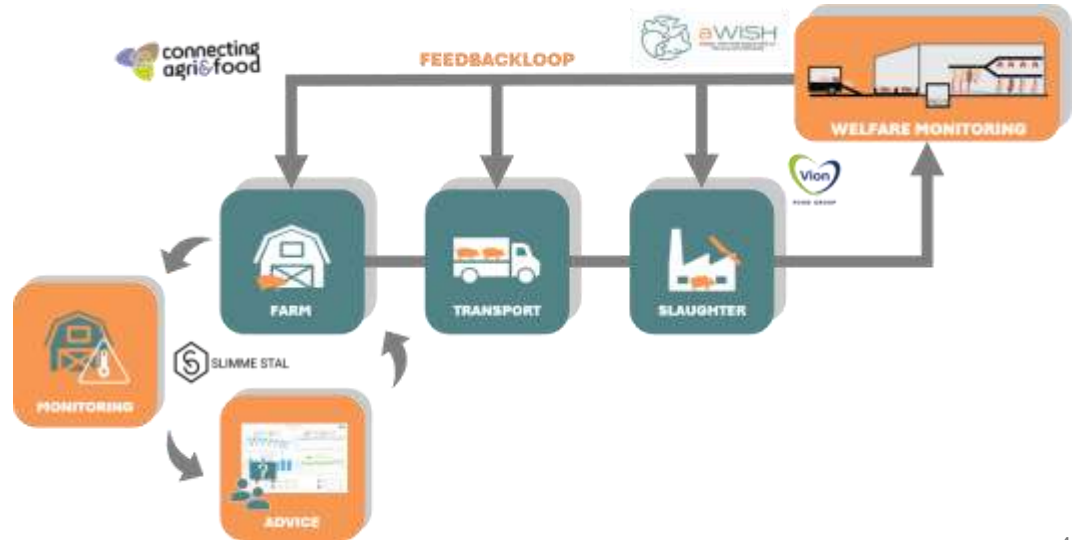
Background



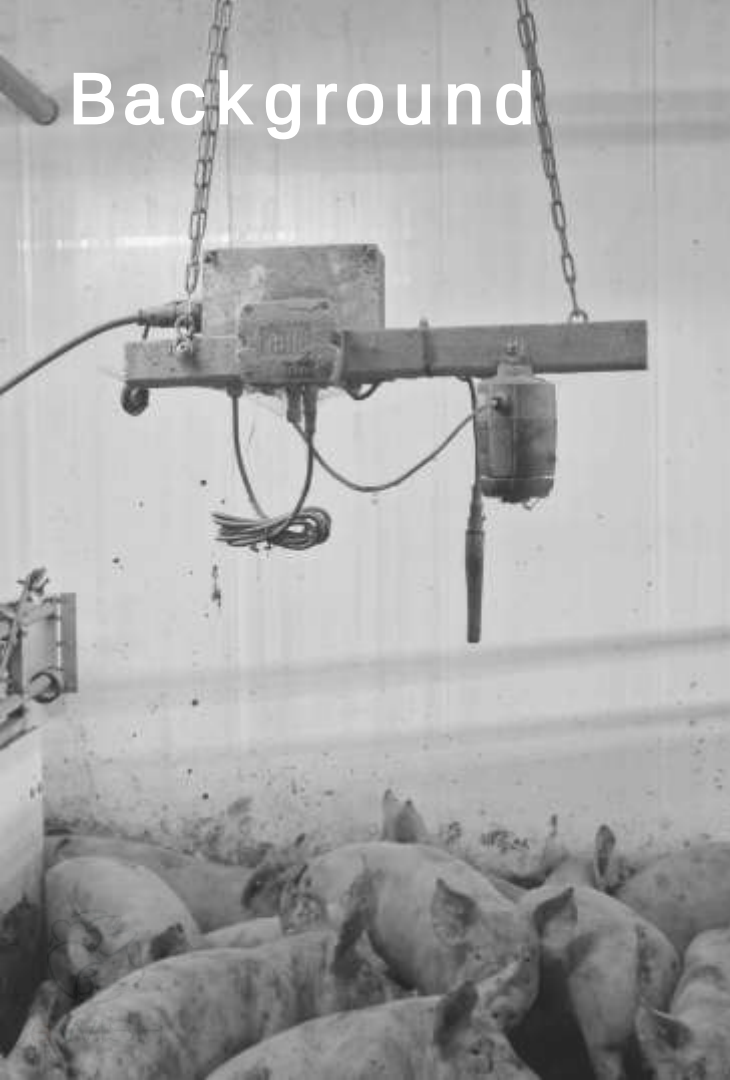
CONNECTING AGRI & FOOD

Intelligent Barn (Slimme Stal) Sensor

- Measures
 - T° and RH
 - Concentration CO_2 and NH_3
- Barn climate advice through experts



Background



POOR BARN CLIMATE

- 🐷 Pig Health
 - 🐷 Well understood
- 🐷 Behaviour & other welfare
 - 🐷 Aversion
 - 🐷 Less understood

PLF – SENSOR DATA

- 🐷 **Farmers don't (like to) make changes**

SCIENTIFIC GAP

**Barn Climate Data + Management Action
→ measurable welfare benefit**



RESEARCH QUESTION



**Does sensor-informed expert
advice improve barn climate
and, in turn, pig welfare?**

Monitoring → Advice → Implementation (?) → Barn climate change (?) → Welfare change (?)



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STUDY DESIGN



INTERVENTION: SENSOR-INFORMED CLIMATE ADVICE

- ❖ No expert climate advice
 - ❖ Farmers have access to sensor data
- ❖ Ethical fail-safe intervention only when required
 - ❖ Not used



CONTROL

V.

ADVICE

- ❖ Weekly expert review of sensor data
- ❖ Practical advice
 - ❖ Ventilation rate
 - ❖ Climate curve



- 9 Dutch farms
 - 2 finisher rounds/farm (same unit)
 - Mechanical ventilation
- Rounds blocked by starting period (+/- 4 weeks)
 - Treatment randomised/Block
- Continuous climate monitoring + repeated welfare measurements (Adapted Welfare Quality®)



$\Delta(V2 - V1)$ Round 1



± 2 weeks
after
mixing



± 1 week
before
slaughter

$\Delta(V2 - V1)$ Round 1



± 2 weeks
after
mixing



± 1 week
before
slaughter

Set up

Slaughter

Set up

Slaughter

MEASUREMENTS



WELFARE QUALITY®

- Adapted – Scored continuously where possible
 - E.g., through a tVAS
- Aggregated up to welfare criteria

	Welfare criteria		Measures
Good feeding	1	Absence of prolonged hunger	Body condition score
	2	Absence of prolonged thirst	Water supply
Good housing	3	Comfort around resting	Bursitis, absence of manure on the body
	4	Thermal comfort	Shivering, panting, huddling
	5	Ease of movement	Space allowance
Good health	6	Absence of injuries	Lameness, wounds on the body, tail biting
	7	Absence of disease	Mortality, coughing, sneezing, pumping, twisted snouts, rectal prolapse, scouring, skin condition, ruptures and hernias
	8	Absence of pain induced by management procedures	Castration, tail docking
Appropriate behaviour	9	Expression of social behaviours	Social behaviour
	10	Expression of other behaviours	Exploratory behaviour
	11	Good human–animal relationship	Fear of humans
	12	Positive emotional state	Qualitative Behaviour Assessment (QBA)

Showed variation between visits and rounds - Analysed Own PCA analysis

FLOW & ANALYSIS

BARN CLIMATE

- Hours above
 - THI (T° & RH) > 70
 - $[CO_2]$ > 2,000 and > 4,000 ppm
 - $[NH_3]$ > 10 and > 20 ppm
- =
- Treatment effect on Barn Climate

AGGREGATED WELFARE

- Aggregated Welfare Quality® criteria
- =
- Treatment effect on overall Pig Welfare

SPECIFIC WELFARE INDICATORS

- Lesions, tail damage, lameness/bursitis, respiratory signs, lying behaviour, body soiling and tear staining (17 total)
- =
- Treatment effect on Specific Pig Welfare Aspects

Statistical Analysis

- LMM: Unit Outcome ~ Treatment + (1|Farm) + (1|Block)
- Welfare: $\Delta(V2 - V1)$ as outcome
 - Tail Length = only V2 as outcome



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ANIMAL WELFARE INDICATORS AT
THE SLAUGHTERHOUSE

awish-project.eu

awish@ilvo.vlaanderen.be

RESULTS



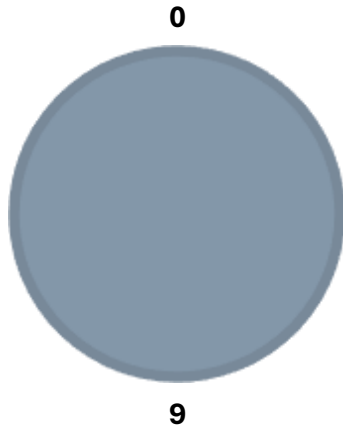
Funded by
the European Union

ADVICE IMPLEMENTATION

5/9 farms implemented barn climate advice in ADVICE rounds

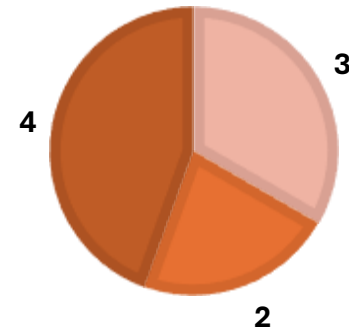
CONTROL

- CONTROL - NO CHANGE IMPLEMENTED
- CONTROL - CHANGE IMPLEMENTED



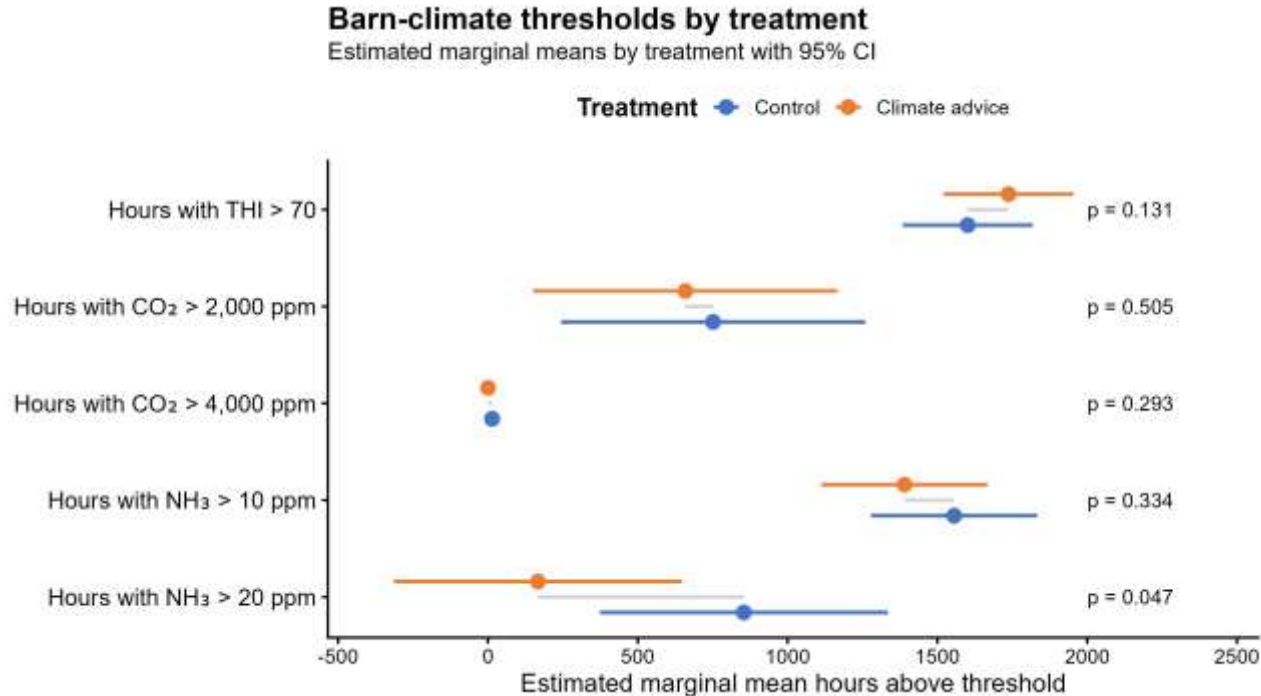
ADVICE

- ADVICE FULLY IMPLEMENTED
- ADVICE PARTIALLY IMPLEMENTED
- ADVICE NOT IMPLEMENTED



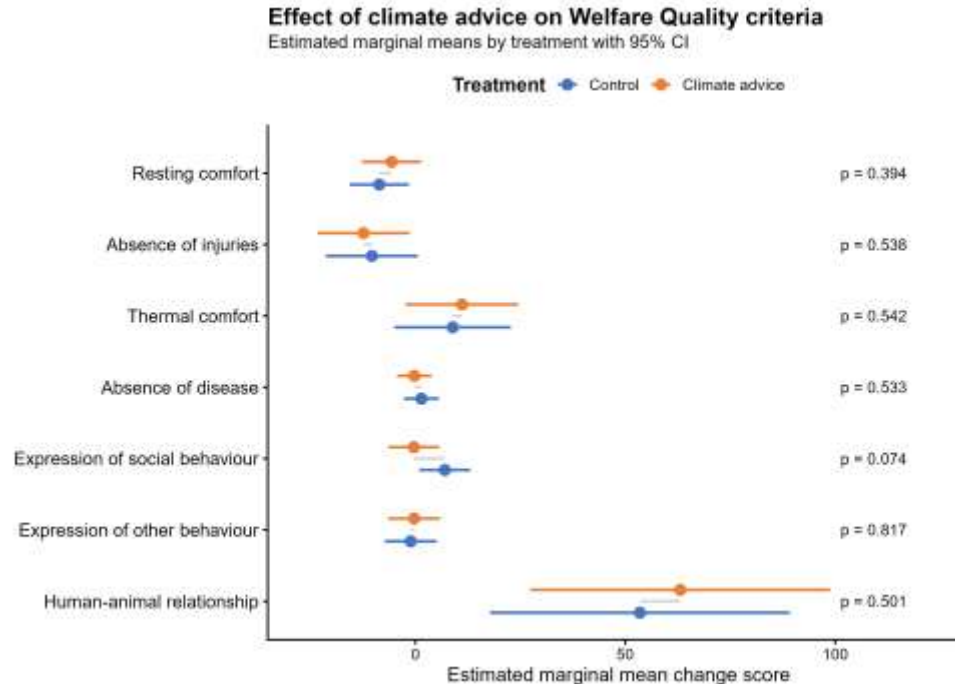
TREATMENT EFFECT ON BARN CLIMATE

Only #hours $\text{NH}_3 > 20$ ppm NH_3 significantly reduced in ADVICE rounds



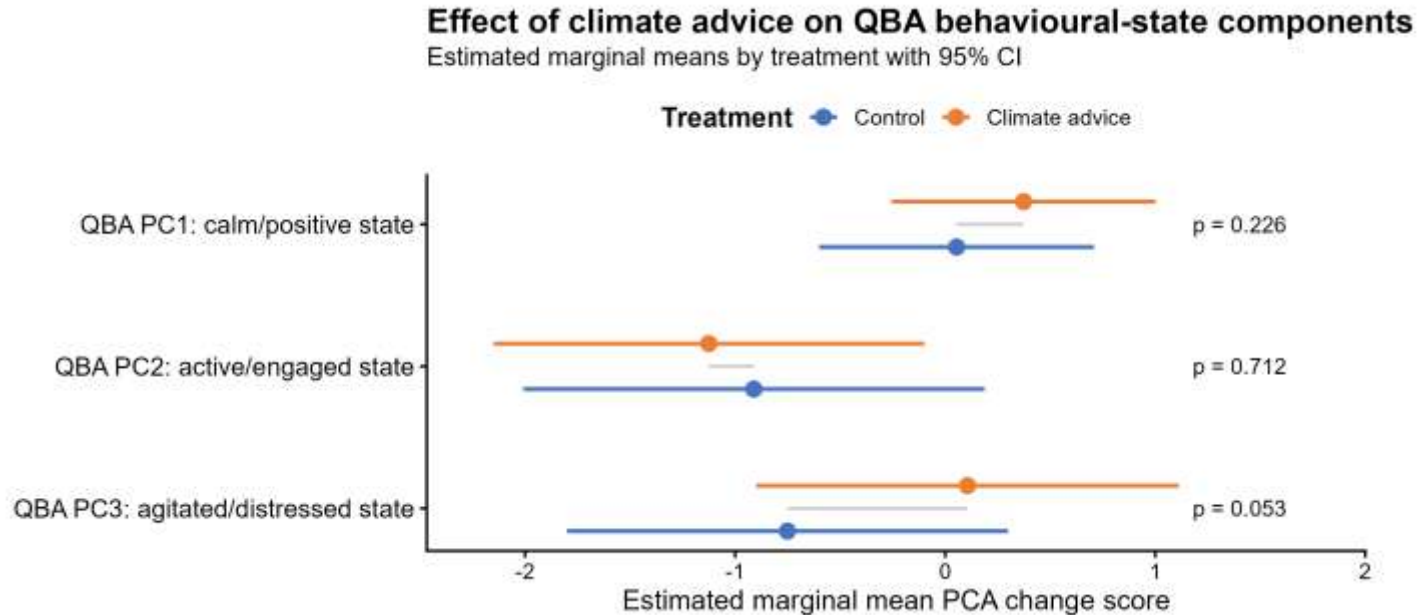
TREATMENT EFFECT ON AGGREGATED WELFARE

No apparent effect of Barn Climate Advice on Aggregated Welfare Quality® Criteria



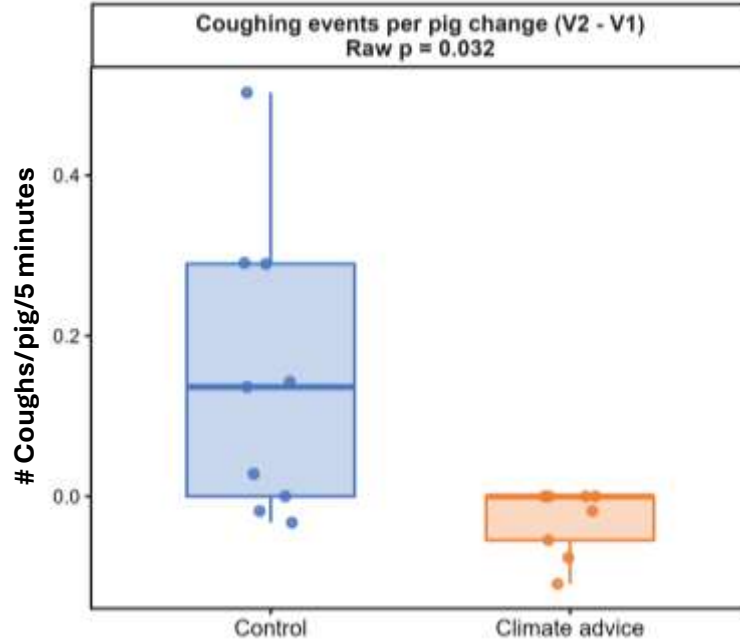
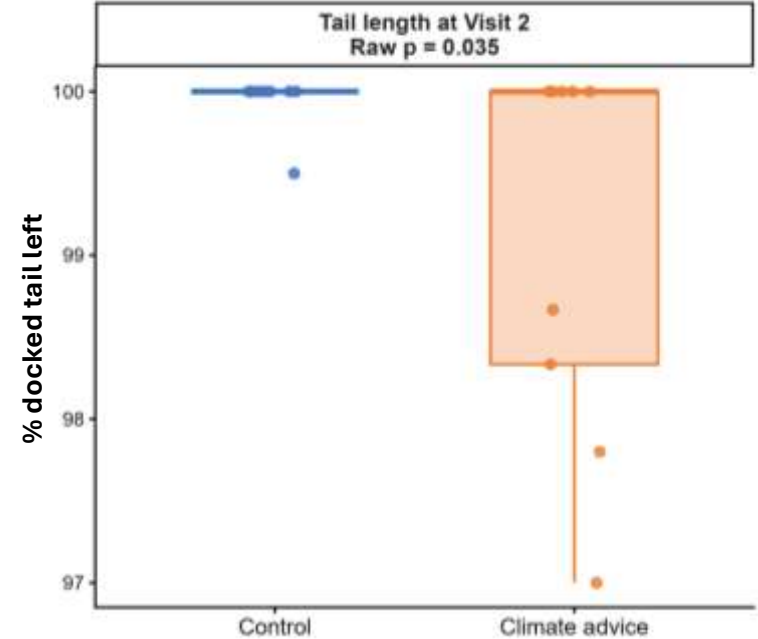
TREATMENT EFFECT ON AGGREGATED WELFARE

No apparent effect of Barn Climate Advice on Aggregated Welfare Quality® Criteria



TREATMENT EFFECT ON SPECIFIC WELFARE INDICATORS

Effect found on Coughing and Tail Length



INTERPRETATION



Intervention fidelity

Only 5 out of 9 farms
implemented the
advice

Environmental contrast

Only fine-tuning of
climate settings

Statistical information

Limited number of
datapoints (18) +
Aggregation effect

STILL →



Reduced exposure to extreme NH_3 concentrations
Coughing and tail length affected by giving advice

Take-home message

- 🐷 Expert advice → implemented by most farmers
 - 🐷 BUT: dialogue is important
- 🐷 Limited barn climate advice can lead to limited improvements in barn climate and welfare changes
- 🐷 Further research needed!



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THANK YOU

CONTACT - Kenny.vanLangeveld@ilvo.vlaanderen.be



Funded by
the European Union



77th EAAP Annual Meeting
Hamburg, Germany

Interactive Catalogue of Precision Livestock Farming Technologies for Automated Welfare Assessment in Pig Slaughterhouses

Ramon-Perez, A., Forkman, B. Manteca, X., and Llonch, P.



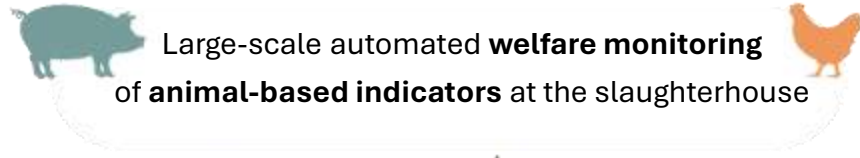
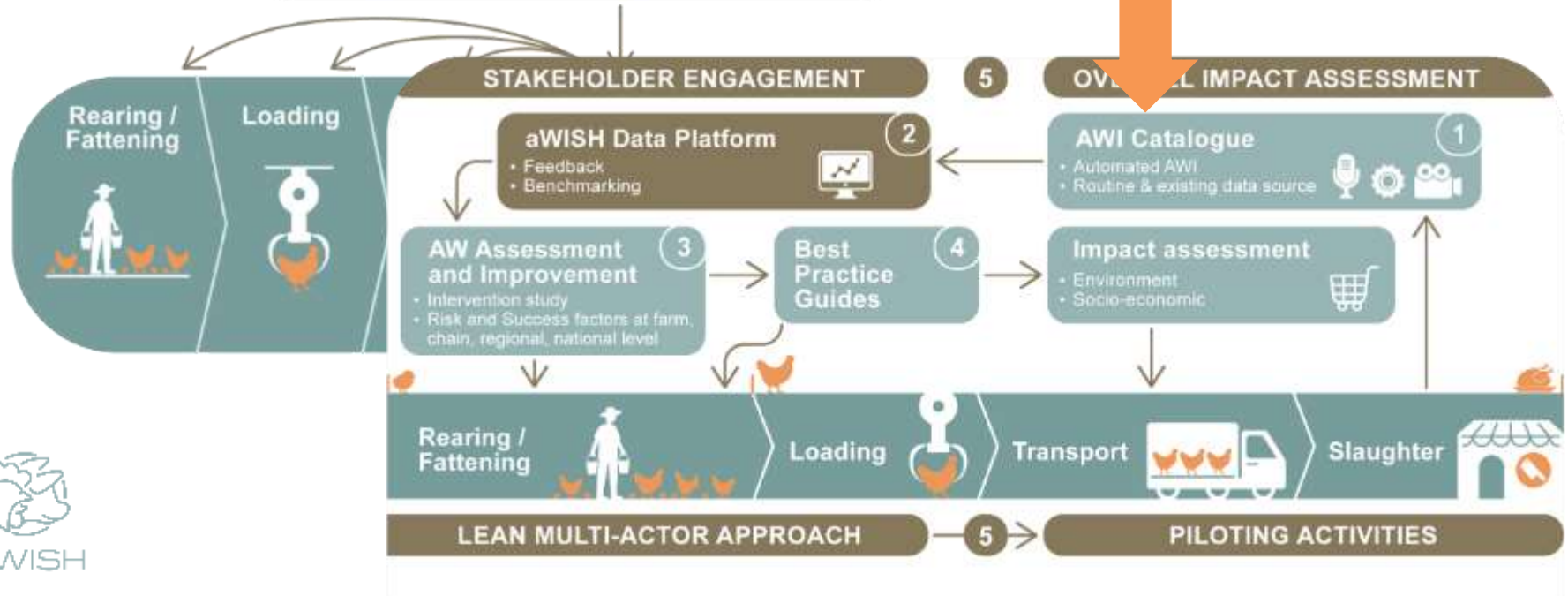
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THE SLAUGHTERHOUSE

UAB
Universitat Autònoma
de Barcelona



UNIVERSITY OF
COPENHAGEN

GENERAL AIM



INTRODUCTION



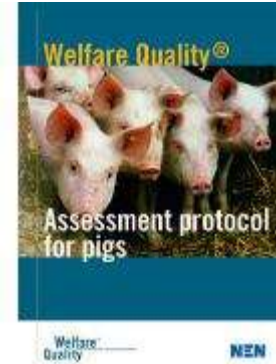
Where should we start?

Animal welfare assessment

Animal-, resource-, and management-based indicators

Precision Livestock Farming

Automation of AW assessment



What technologies allow us to assess animal welfare at the slaughterhouse?



MATERIALS AND METHODS



Systemat

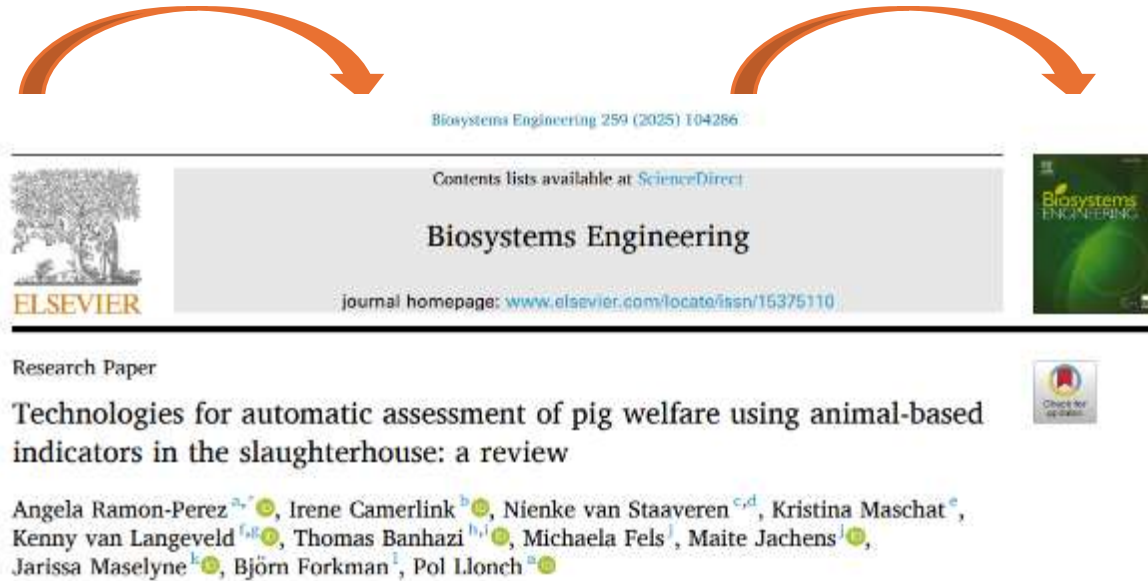


AW indi

Web of Science, S

n = 118 papers

n = 73 indicators



urvey

n = 39

complete
ition

AW, PLF, veterinarians

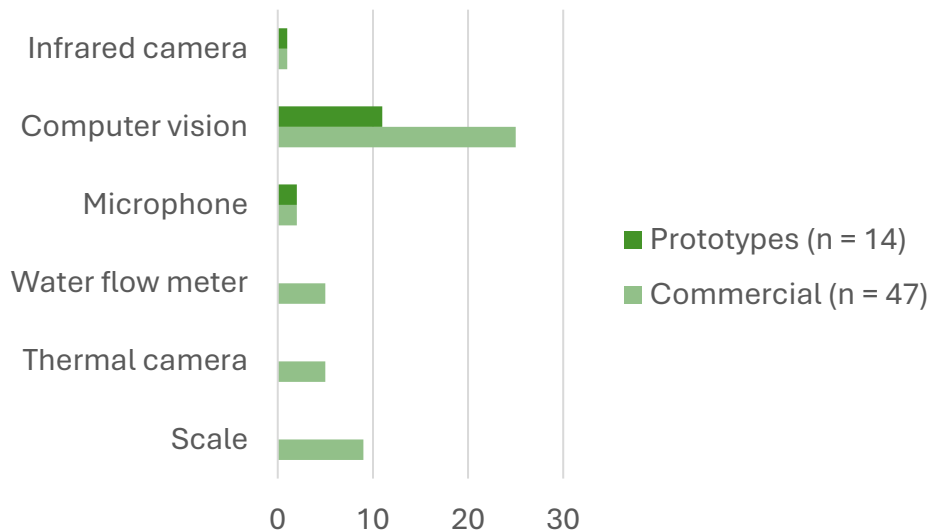
RESULTS



A total of 61 technologies were identified.

These were divided into three phases:

- ***Antemortem***: from the animals' arrival at the slaughterhouse through the stunning phase (n=48)
- ***Stunning***: stunning and slaughtering (n=5)
- ***Postmortem***: includes all procedures performed on the carcasses (n=8)



RESULTS



ANTEMORTEM

Domain	Indicator	Technology	C (P)
Nutrition	Body weight	CV	9 (2)
		Scale	9
	Water consumption	Flow meter	5
Health	Cough	Microphone	2
Behaviour	Tail biting	CV	0 (1)
	Activity	CV	3 (1)
Mental state	Vocalisations	Microphone	0 (1)
	Human-animal interaction	CV	6 (1)
Environment	Noise	Microphone	1
	Space availability	CV	1
	Body temperature	Thermal camera	4
		Infrared camera	1 (1)

STUNNING

Domain	Indicator	Technology	C (P)
Health	Stunning effectiveness	CV	1 (1)
	Killing effectiveness	CV	2
		Thermal camera	1

POSTMORTEM

Domain	Indicator	Technology	C (P)
Health	Skin lesions	CV	2
	Tail lesions	CV	1 (2)
	Tail length	CV	0 (3)
	Lung lesions	CV	0 (2)
Mental state	Tear staining	CV	0 (1)

Updated!



AWI CATALOGUE



Catalogue of AW indicators and PLF tech → Interactive document – aWISH website

Indicators are organised in two sections:



- Pigs

- Broilers



Each section is further divided in three phases:

- **Antemortem**: from animals arrive at slaughterhouse until the stunning phase
- **Stunning**: covering stunning and slaughtering
- **Postmortem**: all procedures performed on the carcasses

Grouped by:

AW Domain > Indicator > Technology



AWI CATALOGUE



About ▾

Notes

Expertise ▾

Communication ▾

AWI catalogue

Data platform



Animal welfare indicators at the slaughterhouse

European project aWISH: focused on automated animal welfare monitoring for broilers and pigs



<https://www.awish-project.eu/>

AWI CATALOGUE



About

plots

communication

AWI catalogue

data platform



AWI catalogue

Click there to see how it works

For some indicators, there is a link to best practice
rules for farmers, transporters and slaughterhouses.



D2.5: AWI CATALOGUE FOR FATTENING PIGS AND BROILERS – FINAL VERSION



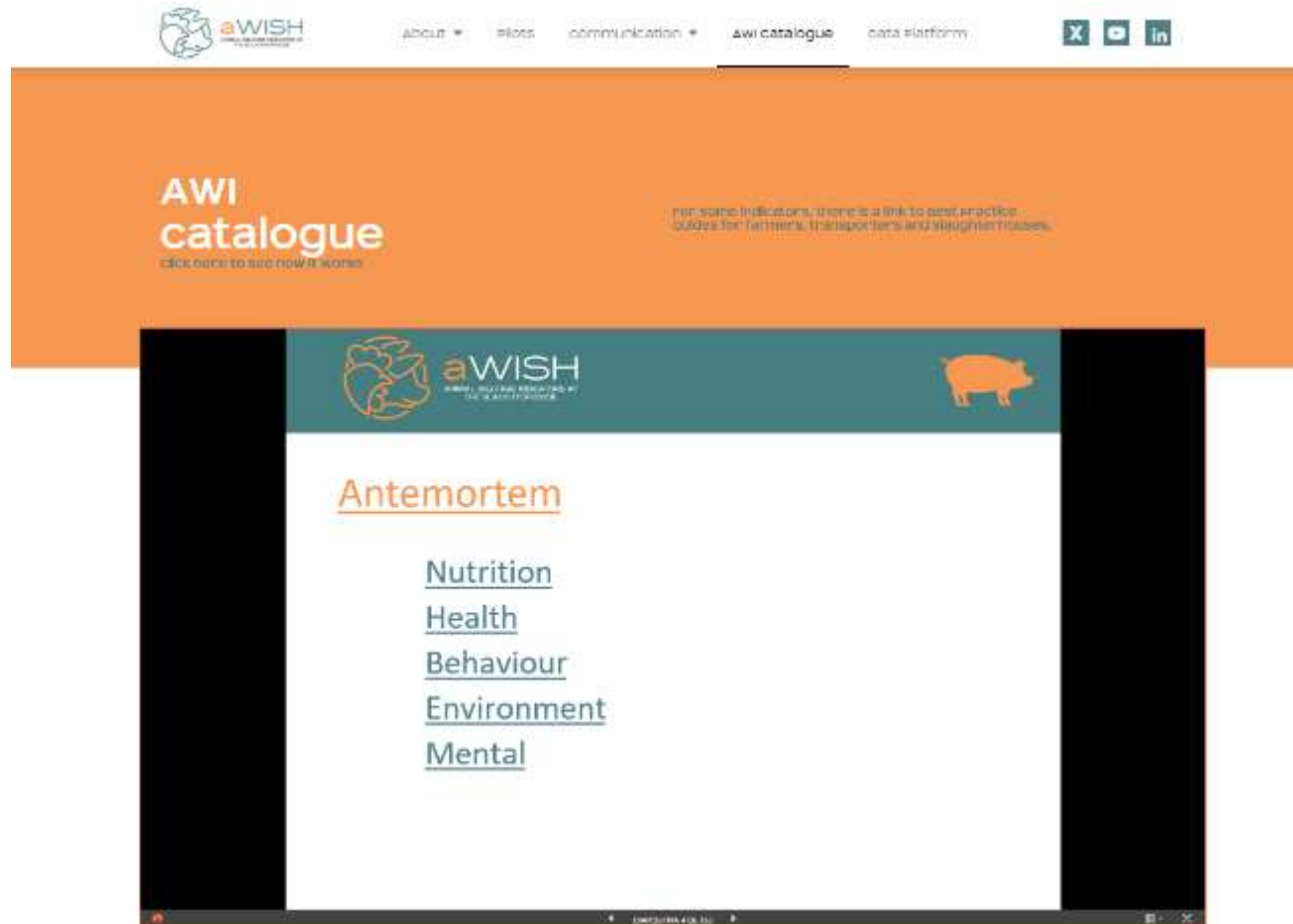
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THE SLAUGHTERHOUSE

Updated September 2026

AWI CATALOGUE



AWI CATALOGUE



AWI CATALOGUE



AWI catalogue
click here to see the AWI website

for some indicators, there is a link to see practice guides for farmers, transporters and slaughterhouses.

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AWI - ALLIANZ INITIATIVE FOR THE S.A.2020 FUTURE


[Antemortem](#)
[Stunning](#)
[Postmortem](#)


[Antemortem](#)
[Stunning](#)
[Postmortem](#)

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AWI CATALOGUE



about ▾ pilots communication ▾ **AWI catalogue** data platform

AWI catalogue

click here to see how it works

for some indicators, there is a link to best practice index for farmers, transporters and slaughterhouses.

**aWISH**
ANIMAL WELFARE INDICATORS AT THE SLAUGHTERHOUSE

Postmortem

Health
Mental

- Skin lesions
- Tail lesions
- Tail length
- Lung lesions

There are no technologies available to measure the nutrition, behaviour and environment domains in postmortem phase

**aWISH**

AWI CATALOGUE



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AWI catalogue

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For some indicators, there is a link to best practice guides for farmers, transporters and slaughterhouses.



HEALTH



Skin lesions

Description

Skin lesions related to aggression can be seen as broken skin causing some degree of blood loss. Increased group stress leads to more aggression-related skin lesions.

Methodology

- Computer vision

- [PigInspector](#)
- [ArtificialVet](#)

Best Practices

AWI CATALOGUE



about

pilots

communication

AWI catalogue

data platform



AWI catalogue

click here to see how it works

for some indications, there is a link to best practice
guides for farmers, transporters and slaughterhouses



HEALTH



PigInspector

Skin lesions

Using computer vision and artificial intelligence installed on carcass procedure line to detect any skin lesions such as joint decubitus, tail necrosis, ear necrosis, tail length, trail marks.



Technology used in aWISH project

Provider	CLK GmbH
Specifications:	Provide 2D and 3D data of the animal
	Customizable algorithms to detect any skin lesion
	Automated system providing real-time data and reports
	Adaptability and integration in specific conditions
	Need of training algorithm to achieve high precision and reliability

Website link

Source: CLK GmbH website

AWI CATALOGUE



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AWI catalogue

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- [ArtificialVet*](#)

Best Practices



For some indicators, there is a link to best practice guides for farmers, transporters and slaughterhouses.

[illegible]



THANK YOU VERY MUCH FOR YOUR ATTENTION!

 angela.ramon@uab.cat

 <https://www.awish-project.eu/>



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awish@ilvo.vlaanderen.be

Ensemble Machine Learning Framework for Automated Cough Detection in Pigs

Dejan Pavlovic



Funded by
the European Union

General

aWISH

Horizon Europe project Research
and Innovation Action

8 000 000 € budget

28 partners | **11** countries | **6** pilots

01 Nov 2022 - 31 Oct 2026



aWISH



PILOT 6 – CARNEX & BIOSENSE



Pilot 6
Carnex



Scientific leader
BioSense Institute

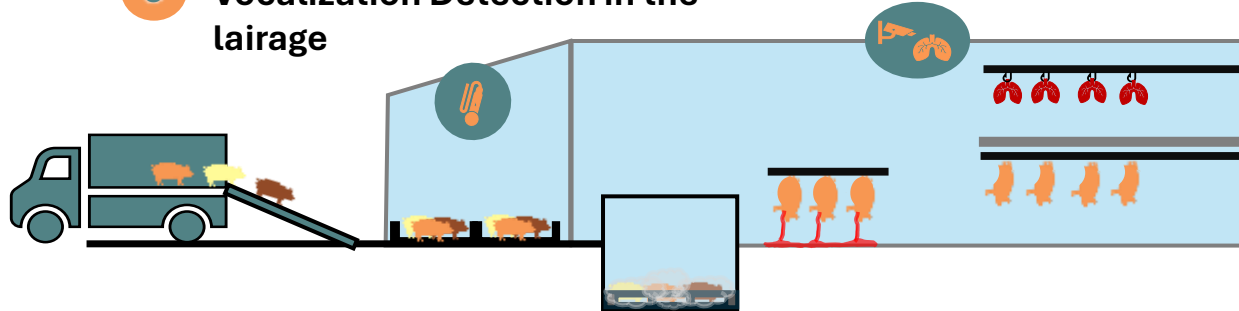
PILOT 6

1 BioSense / Cough Detection -On the Farm

2 Innotech / EnviroDetect Environmental Parameters on the farm

3 FBN / Stremodo – Stress Vocalization Detection in the lairage

4 Innotech / Lesion Detection Lung and Liver Lesions at the slaughterhouse



Why automated cough detection?



RESPIRATORY HEALTH

Coughing is an acoustic indicator of respiratory health

CONTINUOUS MONITORING

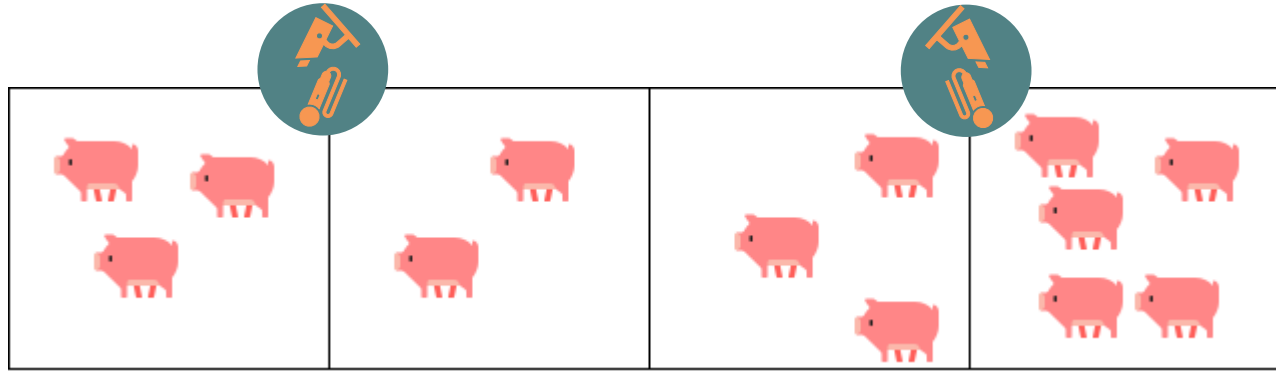
Manual observation cannot provide continuous farm-level monitoring

AUTOMATION

Farm microphones can potentially enable continuous, non-invasive detection



Farm setup



TECHNOLOGY PROVIDER



Animal Sense data platform

1

Video Search

Date range: 2025-01-22 → 2025-01-23

Trigger type: VideoMotion × AudioAnomaly × AudioMutation ×

Tag: ☐ Classified

2

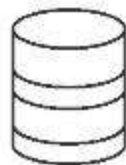
Available Videos

1. 2025-01-22 16:47:04	Show video
2. 2025-01-22 16:46:14	Show video
3. 2025-01-22 16:43:04	Show video
4. 2025-01-22 16:40:12	Show video
5. 2025-01-22 16:37:04	Show video
6. 2025-01-22 16:35:14	Show video

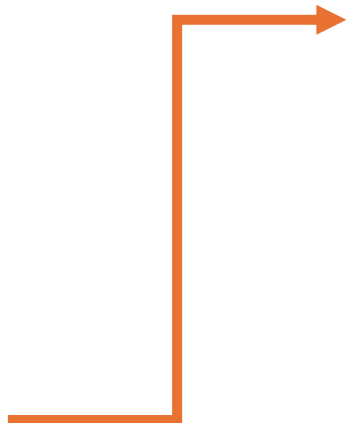
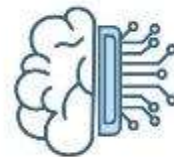
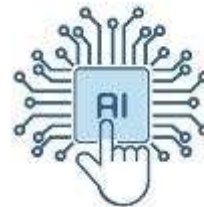
< 1 2 3 4 5 ... 19 >

3





3000
minutes



cough/other

**Cough events
annotation**



**Dataset
Preparation**



**Model
Training**



Prediction

Data preparation



15 min audio

Butterworth filtering



60-second intervals around cough events

70 intervals — training/validation

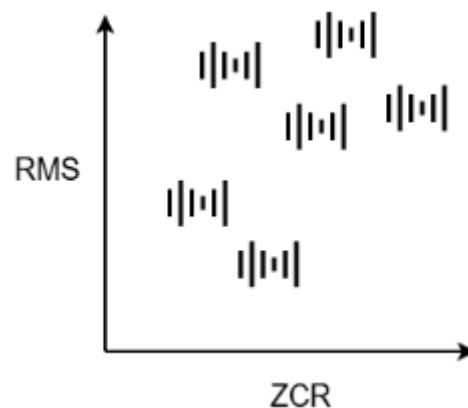
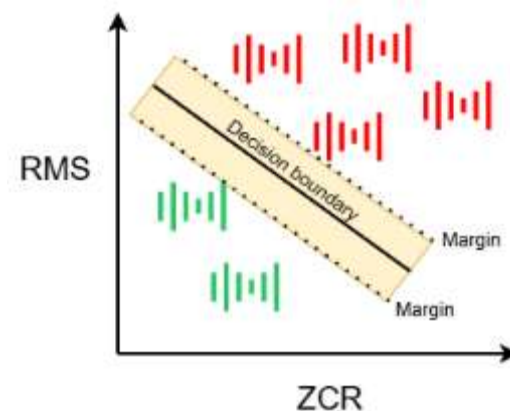


10 intervals — test



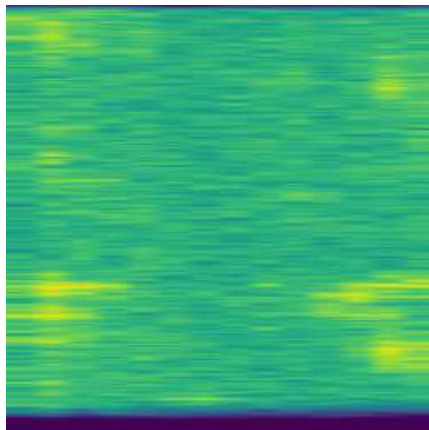
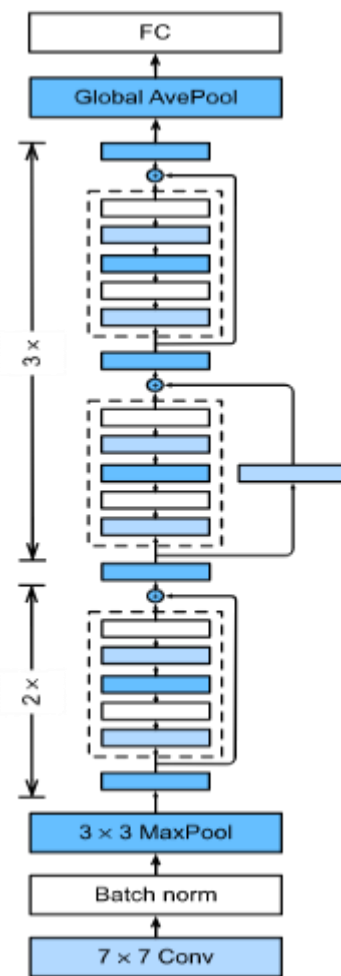
Classical machine learning approach

- **Input:** 1-second audio windows with 50% overlap
- **Features:** 21 time-domain/spectral acoustic features
- **Feature selection:** Backward Feature Elimination
- **Classifier:** Support Vector Machine (SVM)
- **Hyperparameter optimization**



Deep Learning approach

- **Input:** 1-second audio windows with 50% overlap
- **Representation:** Spectrograms generated using the FFT
- **Classifier:** ResNet-18
- **Transfer learning:** Deeper layers and classification head fine-tuned



or

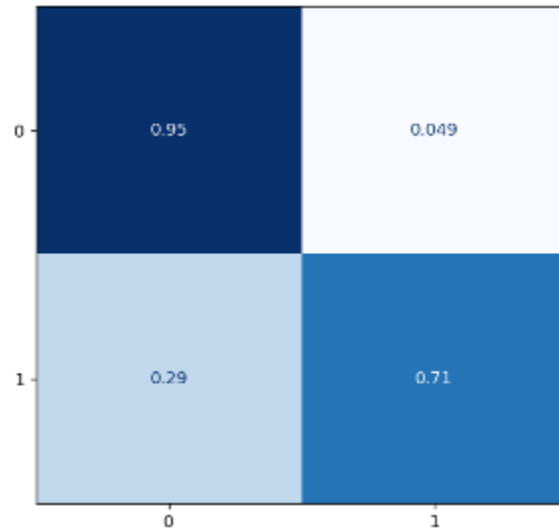


Classification performance

SVM

Accuracy: 0.91

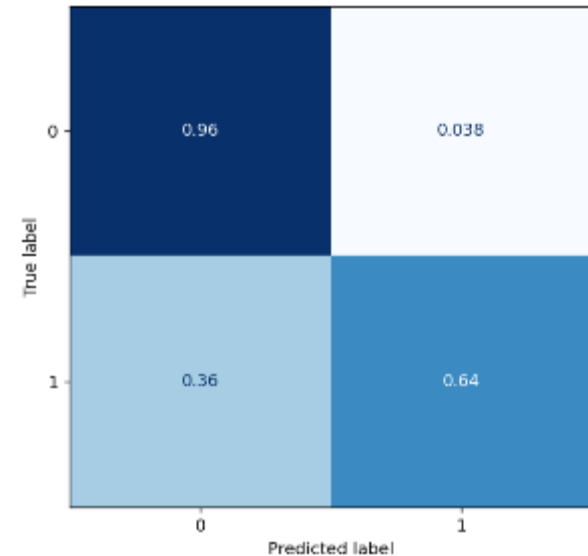
F1 score: 0.73



ResNet-18

Accuracy: 0.89

F1 score: 0.71

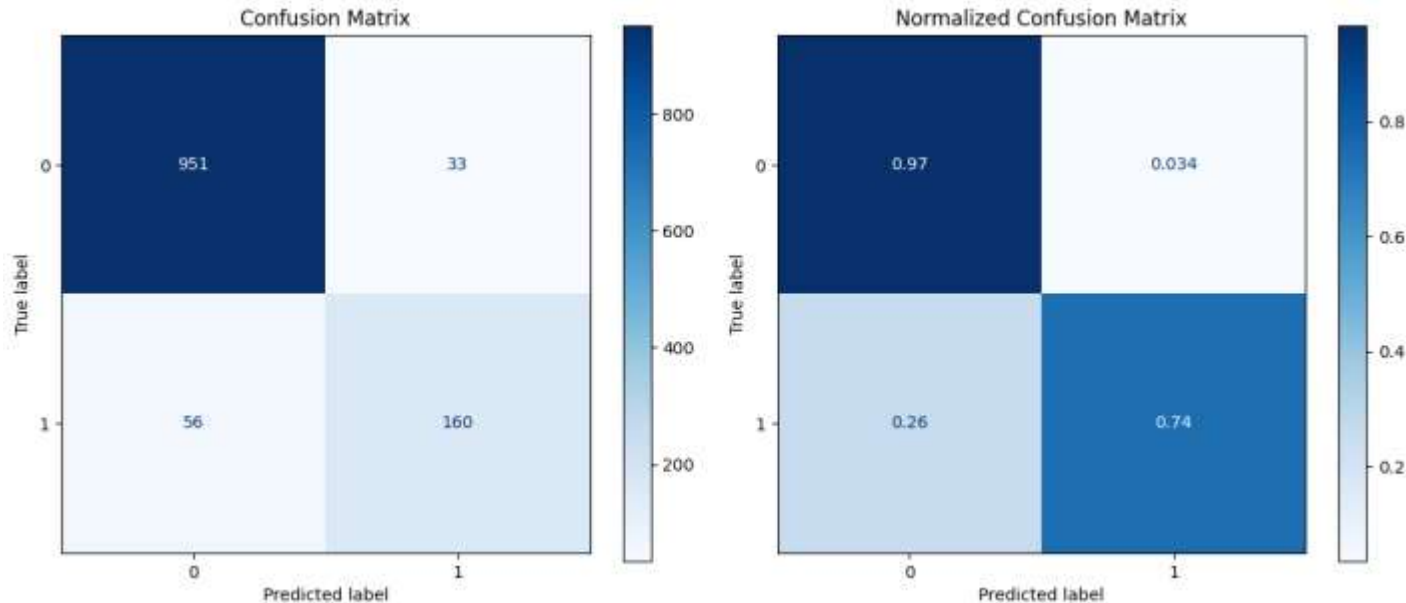


Model fusion

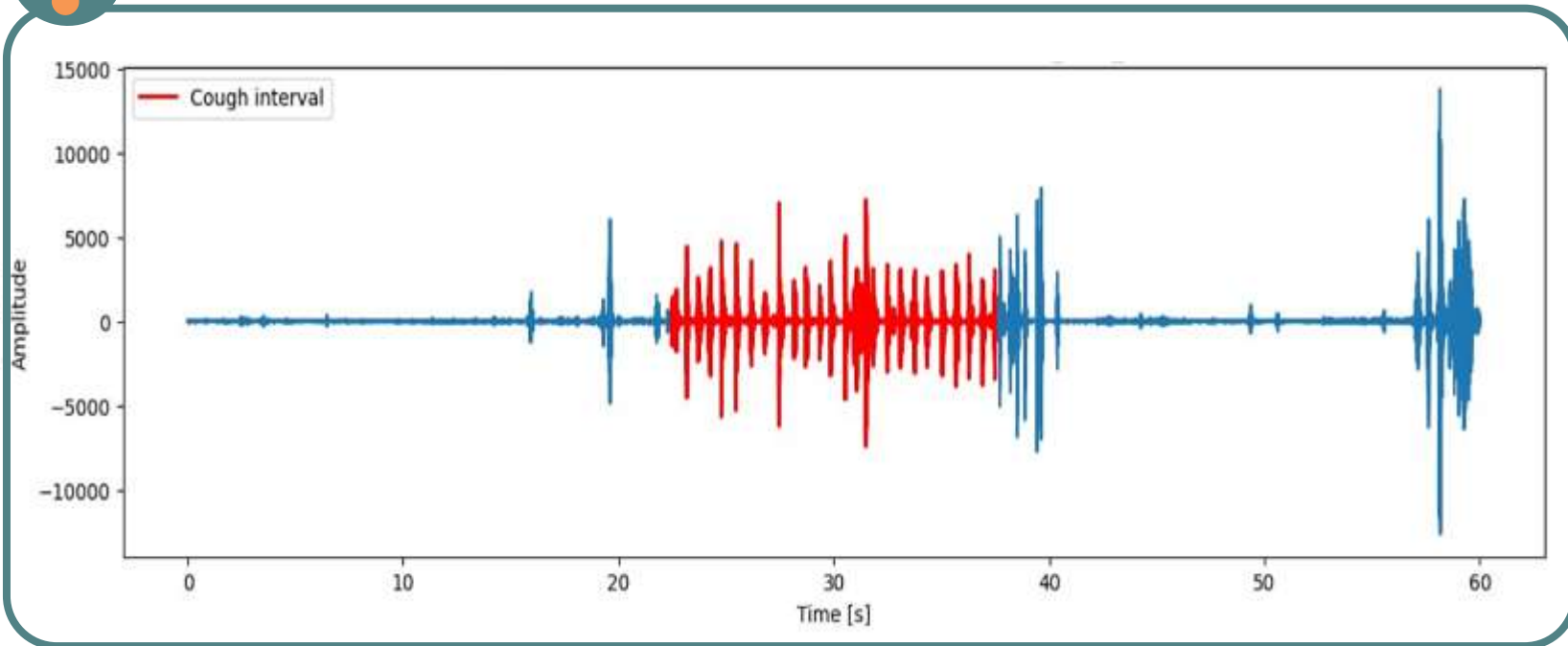
$$w * p_{\text{svm}} + (1 - w) * p_{\text{ResNet}}$$

Accuracy: **0.93**

F1 score: **0.78** (SVM - 0.73; ResNet - 0.71)

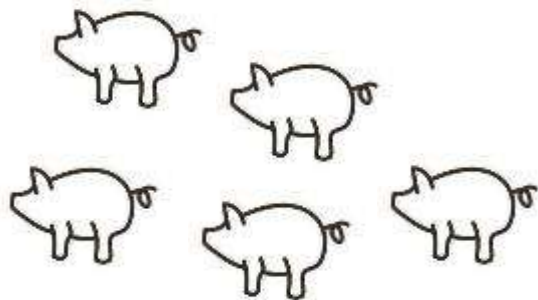


Prediction

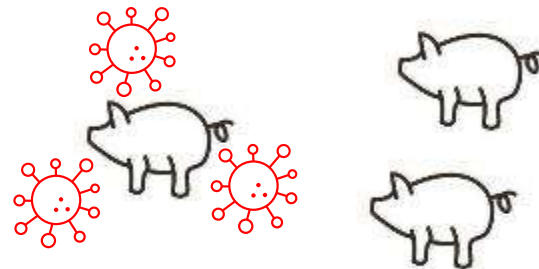
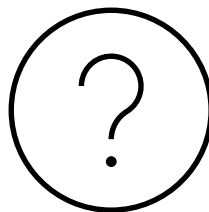




Cough detected



Cough detected



RMS

Discrimination accuracy > 85%

Aktivnost kašlja

Akustička detekcija iz Animal Sense pipeline-a.

• 31. septembar je prethodnog dana je učestvovao

SEKUNDI KAŠLJA - POSLEDNJI DAN

660.5 s

kroz 153 događaja, 24 snimke

DETEKCIJE - POSLEDNJI DAN

1168 proc.

podizanih praga

DOGAĐAJI KAŠLJA - POSLEDNJI DAN

153

▲ 50 u odnosu na dan ranije

DOGAĐAJI - POSLEDNJIH 7 DANA

704

maks. verovatnoća 0.02

Indikator anomalije kašlja - 7 dana

Pokazuje koliko je aktivnost kašlja neuobičajena u odnosu na sopstvenu istoriju prostorja. Nije dijagnoza. Prikazuje se uz skrove sekunde kašlja, jer hronično povišen kašalj može očitati nizak skor anomalije.

ANOMALIJA - POSLEDNJI DAN

100 / 100

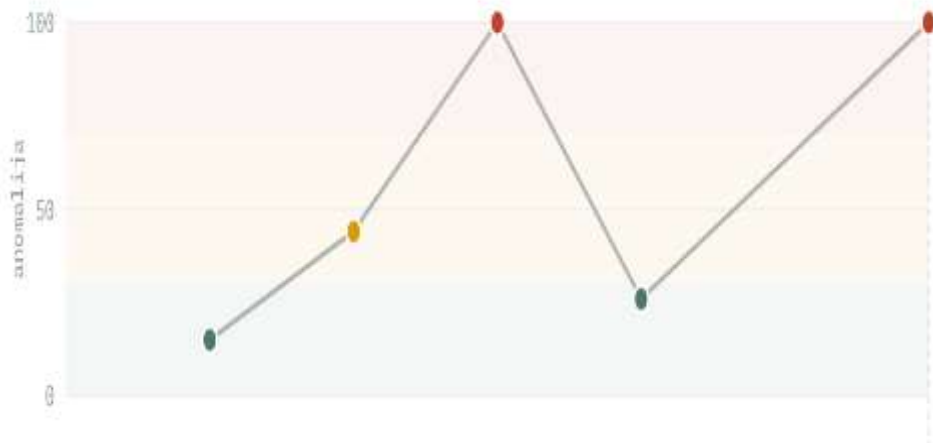
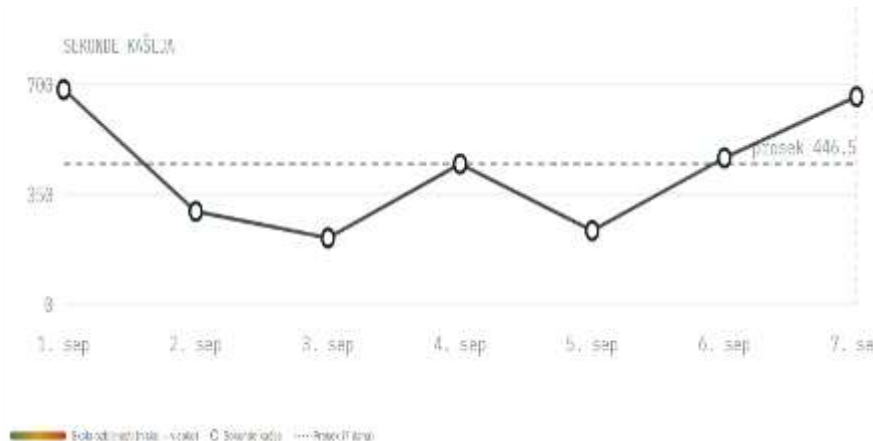
● Visoko

KAŠALJ - POSLEDNJI DAN

660.5 sek.

↑ iznad proseka (prosek 446.5 s)

▲ Visoko — preporučeni pregled prostorja



Thank you for your attention!



website: awish-project.eu
email: awish@ilvo.vlaanderen.be



<https://www.awish-project.eu/>

Dejan Pavlović
[dejan.pavlovic@biosense.r](mailto:dejan.pavlovic@biosense.rs)

S



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ANIMAL WELFARE INDICATORS AT
THE SLAUGHTERHOUSE

Validation of a Computer Vision– Based Tail-Length Measurement Algorithm for Finishing Pigs at the Slaughterhouse

C. Pfeiffer^{1*}, K. Maschat¹, S. Kalgburi², A. Voss², C. Bonk² and
J. Baumgartner¹

¹Center of Animal Nutrition and Welfare, Clinical Department for Farm Animals and Food
Systems

²CLK GmbH Bildverarbeitung und Robotik, Altenbergen, Germany

77th EAAP | 07th – 11th Sept. 2026 | Hamburg, Germany



vetmeduni

University of Veterinary Medicine, Vienna



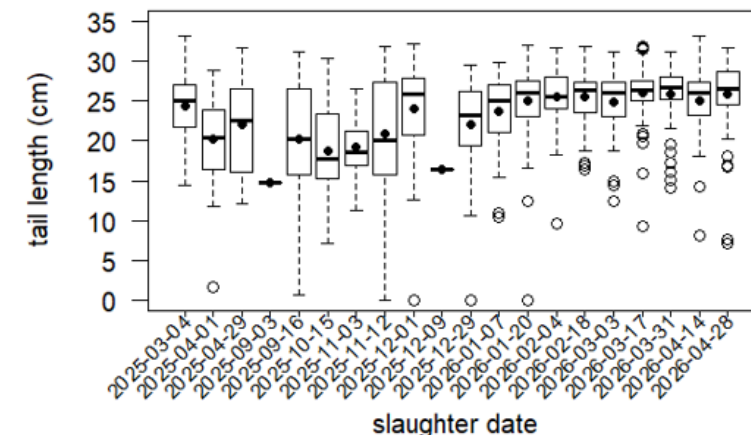
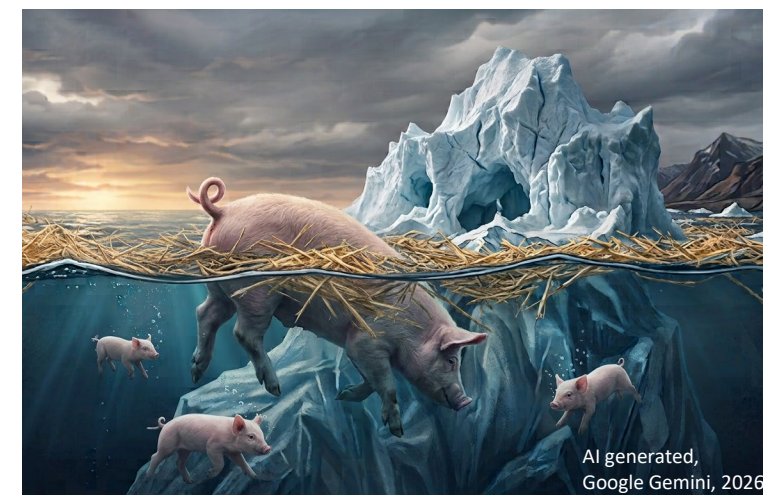


The pig tail as an iceberg indicator

Tail length captures the history:

- **Tail biting** (multifactorial, complex problem)
 - Stumpy tails, uneven length across batches (large variation)
- Tail-docking (procedure to reduce the risk of tail biting)
 - Routine **tail-docking** is prohibited in the EU
- On-farm assessment is extremely time consuming, expensive and subjective
- Increased interest in large-scale **automated monitoring** in **slaughterhouses**

→ **Retrospective assessment of animal welfare possible**





Validation

Internally:

- Quantifies apparent performance on development data and adjusts for optimism due to overfitting

Externally:

- Evaluates performance on independent data from different settings to test transportability and generalizability

Both are rare in Precision Livestock Farming (PLF)

→ **Rigorous internal and external validation needed before implementing a technology**





Development, comparison, internal and external validation
of real-time **computer-vision** based algorithms
to measure **tail length as a continuous variable**
in **finishing pigs** at two **slaughterhouses**

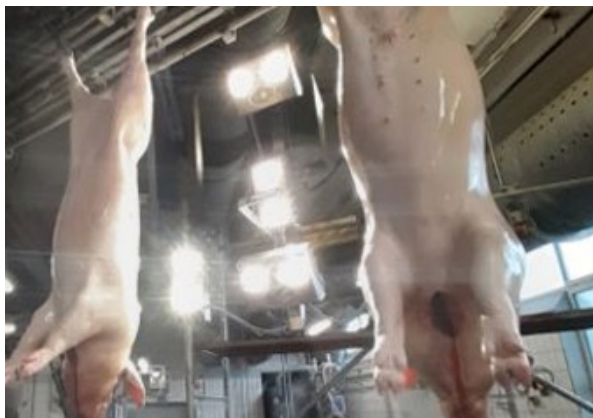
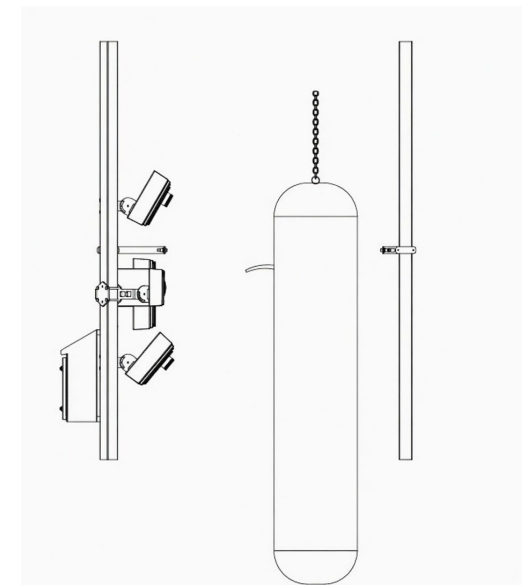
→ **Does the sensor technology measure the same
animal-based measure in both slaughterhouses?**





Technical setup – PigInspector (CLK GmbH, Germany)/ study location

- One stereo 3D camera (hind legs) with pattern projection
- Five/three 2D color cameras with auxiliary illumination (hind leg, back, head (two lateral sides))
- Upstream the decontamination area
- ORC algorithm for individual animal identification or manually marked
- Austrian and Dutch slaughterhouse (SH A and SH B)





Algorithm development

- Based on SH A → applied to SH B

Two-step approach for tail length measurement (cm):

1) Annotation of 1.252 hind leg images using CVAT based on SH A data

- Training (n=876), validation (n=188), test (n=188)

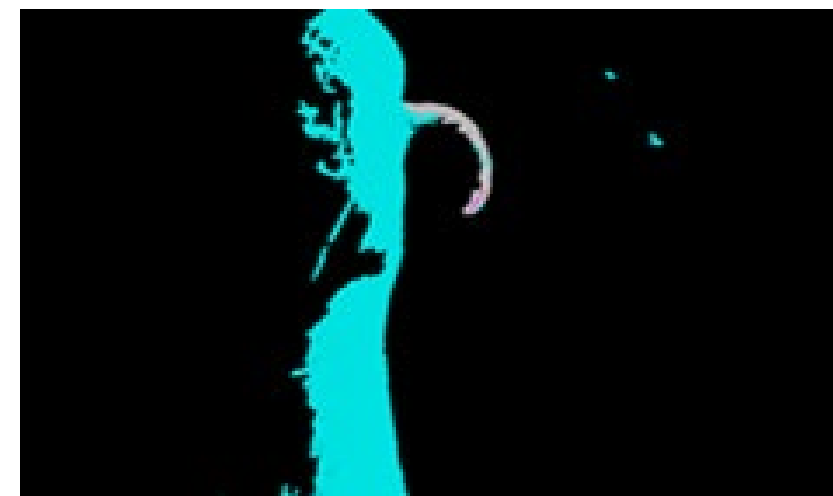
- YOLOv8n segmentation model was trained

→ Precision: 0.97/0.98 for mask & box

→ Recall: 0.98/0.97 for mask & box

→ mAP@50-95: 0.84/0.89 for mask & box

Nearly perfect detection and coarse localization





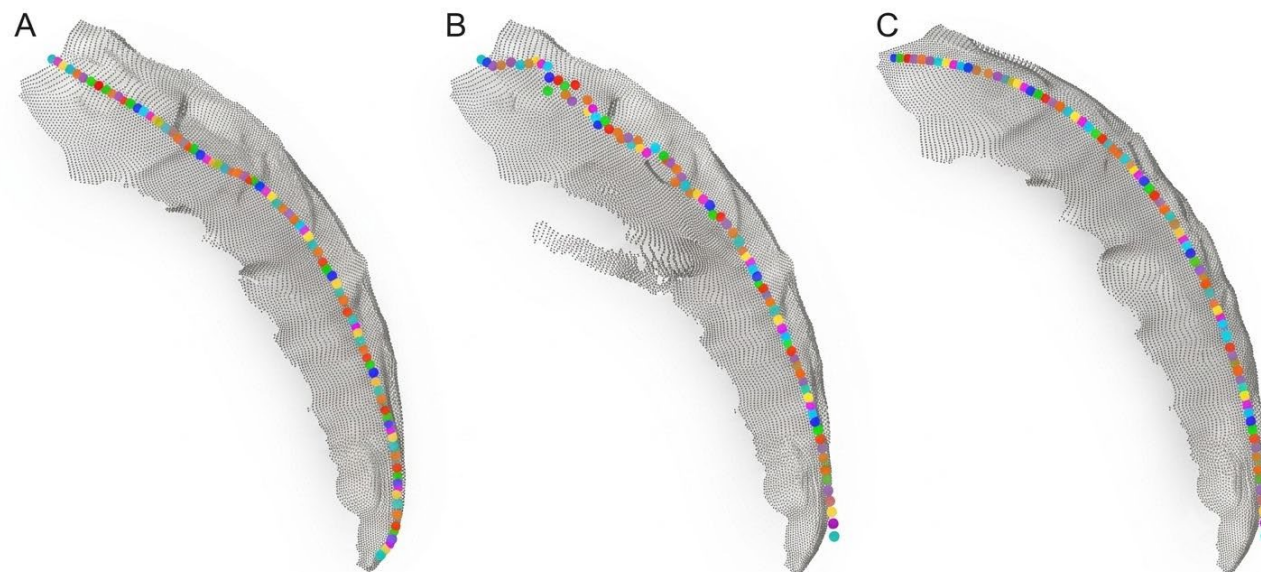
Algorithm development

- Based on SH A → applied to SH B

Two-step approach for tail length measurement (cm):

2) Geometric tail length estimation

- A: Top-Surface Centerline
- B: Center-Top Centerline
- C: 2D Skeleton Projection





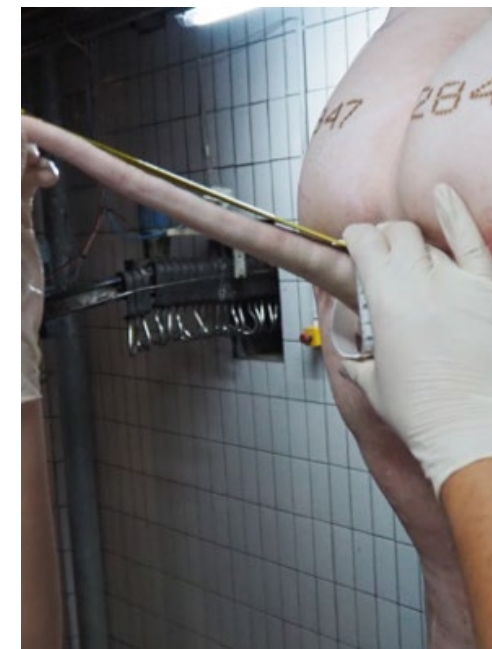
Reference data – manually measured tail length (cm)

Slaughterhouse A – internal validation

- 1,102 tails measured/ 686 left for statistical analysis
- *TailSizer*
- Inter-observer training conducted
(intra-class correlation coefficient based on 100 tails: 0.97)

Slaughterhouse B – external validation

- 1,261 tails measured/ 423 left for statistical analysis
- *TailSizer*

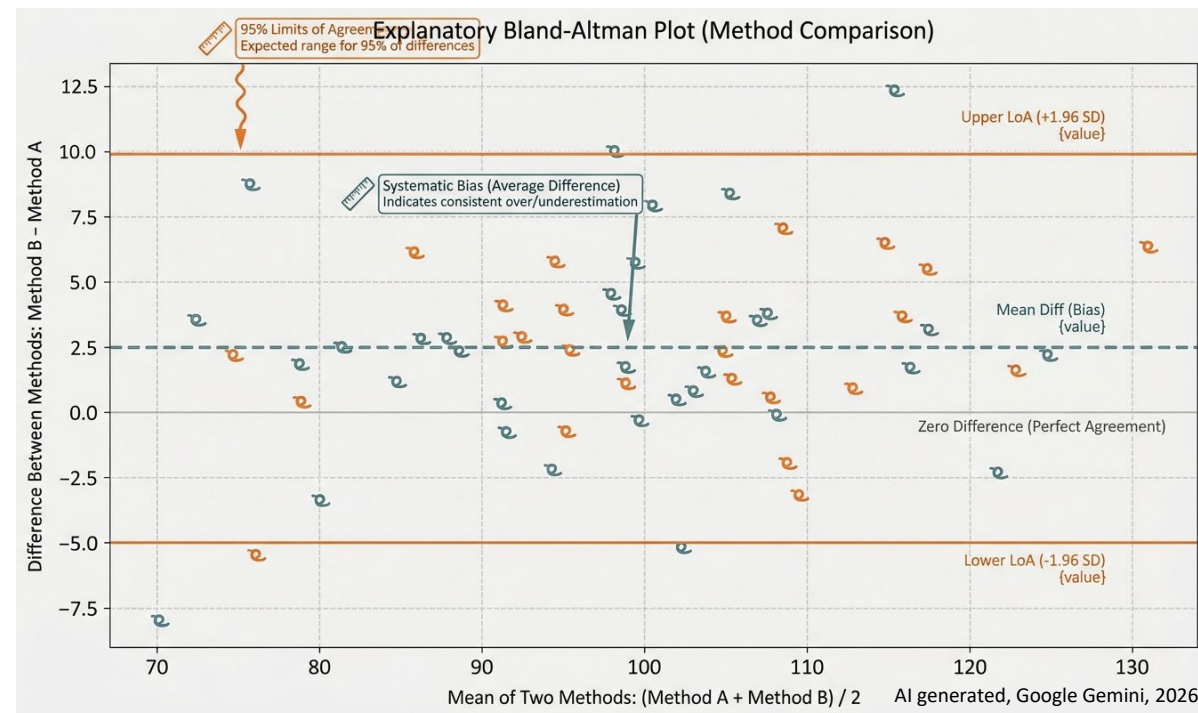




Validation - reference data – manual tail length measurements

- Descriptive statistics
- Mean absolute error (MAE)
- Bland-Altman analysis
(bias, SD, 95 % Limit of Agreement (LoA))
- Spearman-rank correlations between methods
(will not be shown)
- Interchangeability of ± 2.00 cm

→ How closely do two measurement methods agree with each other across different values, and is their difference small enough to use them interchangeably?

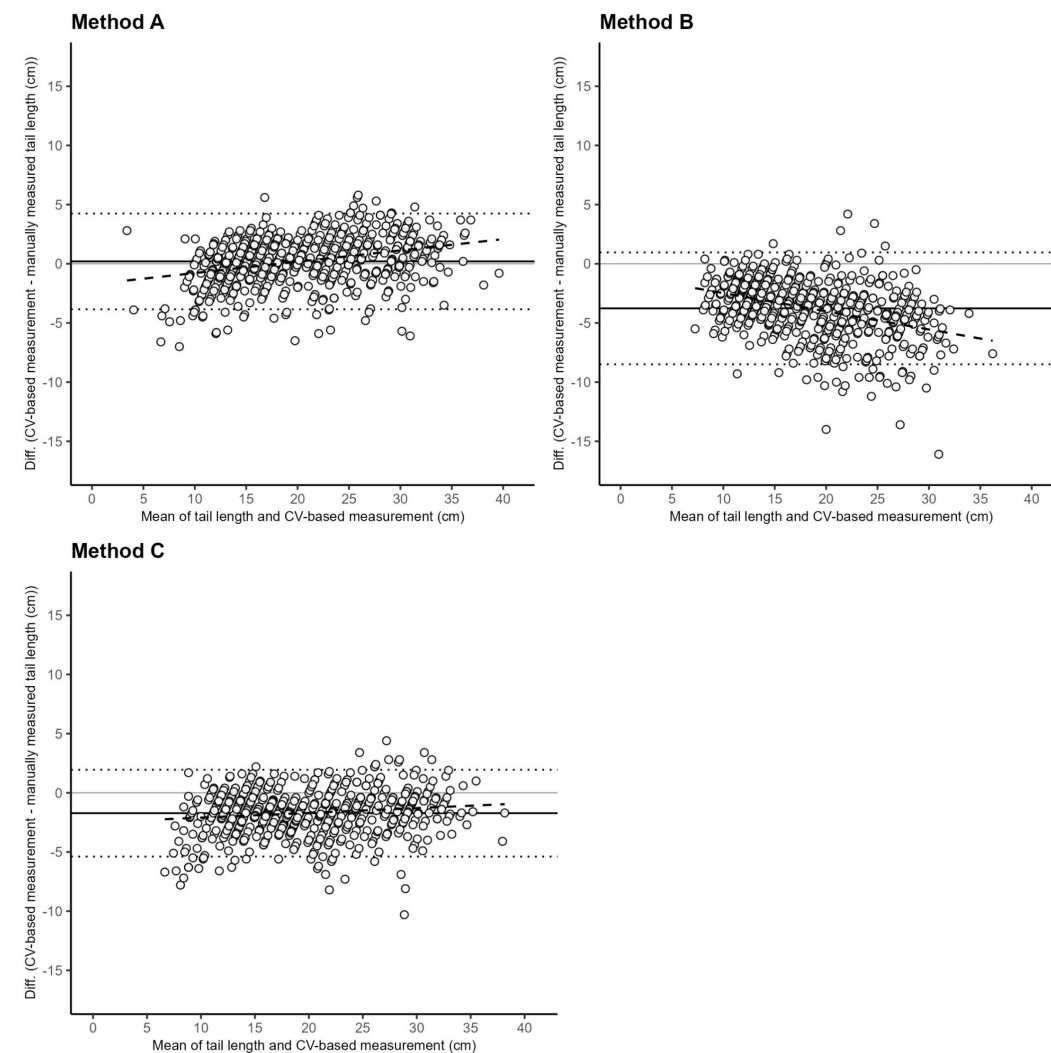




Internal validation tail length (cm)

(n=686)

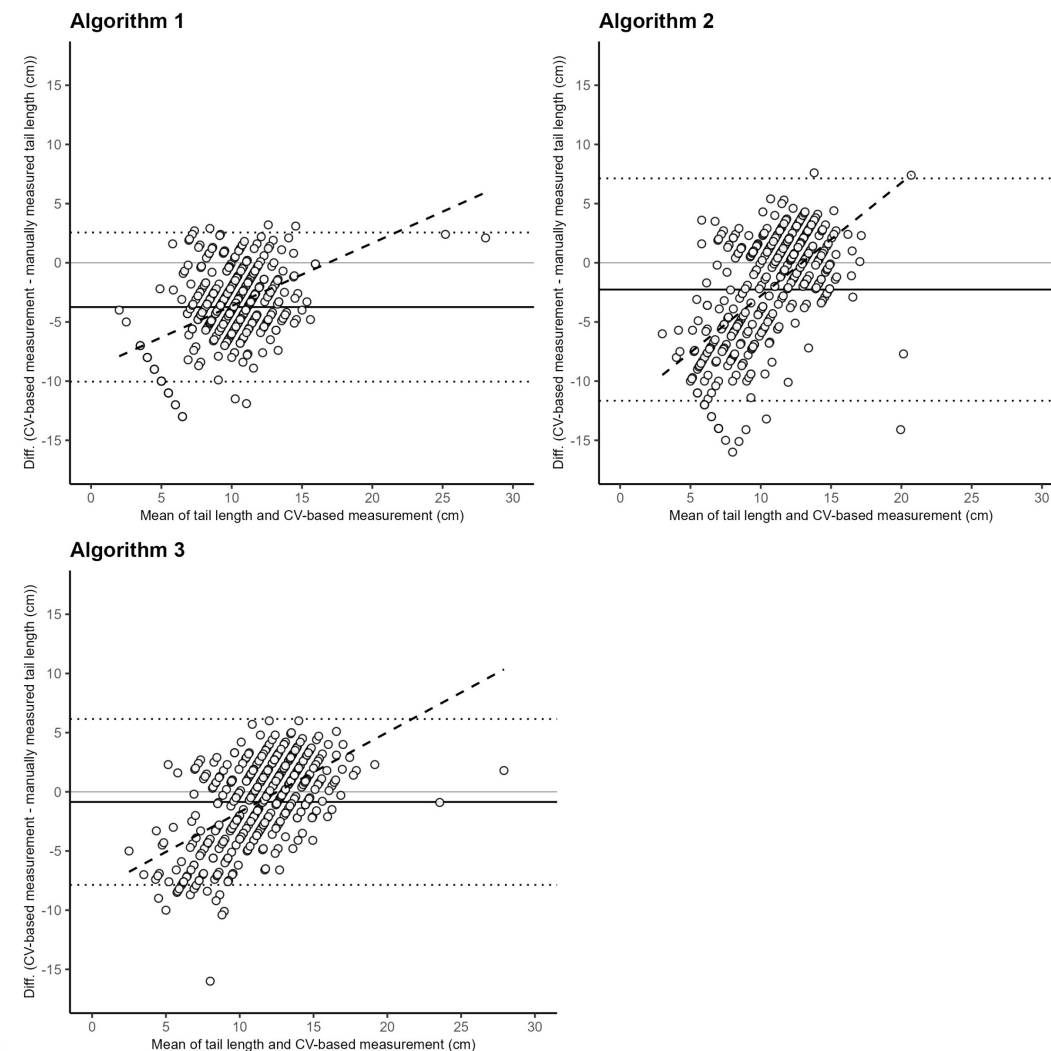
Method	$\bar{x} \pm s$	Min – max	MAE	mean bias $\pm s$	95% LoA
Reference Data	20.2 $\pm$ 6.54	2.00 – 40.00	---		
A	20.4 $\pm$ 7.18	2.10 – 39.20	1.63 $\pm$ 1.28	0.20 $\pm$ 2.07	-3.85 – 4.25
B	16.2 $\pm$ 5.97	0.00 – 32.4	4.05 $\pm$ 2.69	-3.77 $\pm$ 2.41	-8.50 – 0.96
C	18.2 $\pm$ 7.17	0.00 – 37.2	2.31 $\pm$ 2.75	-1.72 $\pm$ 1.87	-5.39 – 1.95





External validation tail length (cm)

Method	$\bar{x} \pm s$	Min – max	MAE	mean bias $\pm s$	95% LoA
Reference Data	11.7 $\pm$ 2.50	4.00 – 27.00	---		
A	8.00 $\pm$ 3.80	0.00 – 29.1	4.06 $\pm$ 2.80	-3.74 $\pm$ 3.21	-10.0 – 2.56
B	9.40 $\pm$ 4.80	0.00 – 24.4	3.98 $\pm$ 3.50	-2.26 $\pm$ 4.79	-11.7 – 7.13
C	10.8 $\pm$ 4.30	0.00 – 28.8	2.88 $\pm$ 2.29	-0.86 $\pm$ 3.58	-7.87 – 6.15





- Internal validation can be considered as **feasible** – agreement was **strong** but not perfect
- **Continuous** measurements are **preferable**
 - No reduction of variability in data
 - For more precise benchmarking purposes (farmers, slaughterhouse, labels, policy markers)
- External validation has **failed**
 - Camera setup and angle
 - Short tails, stump tails, rotating carcasses
 - Different slaughterhouse environments need to be considered

→ **CV systems are promising to collect high- throughput animal-based measured data and has high potential to improve welfare**



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**Thank you for
your attention!
Questions?**



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THE SLAUGHTERHOUSE



christina.pfeiffer@vetmeduni.ac.at



[aWISH – Animal Welfare Indicators at the
Slaughterhouse \(awish-project.eu\)](http://awish-project.eu)



Funded by
the European Union

Can we monitor stunning effectiveness continuously?

From manual checks to continuous monitoring



Automated real-time monitoring of corneal reflex using computer vision to assess stunning effectiveness in a commercial pig slaughterhouse

Jordi Sanchez-Cañadó, Angela Ramon-Perez, Vicky Garcia-Vera, Just Plà-Claver, Josep Reixach, Jordi Canet, Sofia Gol, Xavier Manteca, Pol Llonch



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UAB
Universitat Autònoma
de Barcelona



Jordi Sanchez-Cañadó • Nuna Solutions
EAAP 2026 • Hamburg

2 Effective stunning is a critical welfare checkpoint

Rapid and effective loss of consciousness

Prevention of unnecessary pain and suffering

A key requirement for animal welfare and legal compliance

EC No 1099/2009

3 The challenge: monitoring every animal

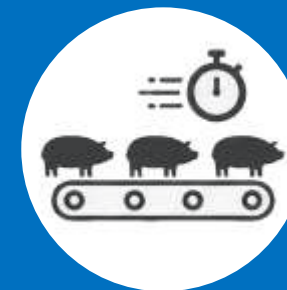


Multiple animal-
based indicators

*posture · breathing
vocalisation · reflexes*



Trained human
assessment



550
pigs/hour

*Commercial slaughter
line*



4 The corneal reflex



Sensitive indicator of possible recovery of consciousness

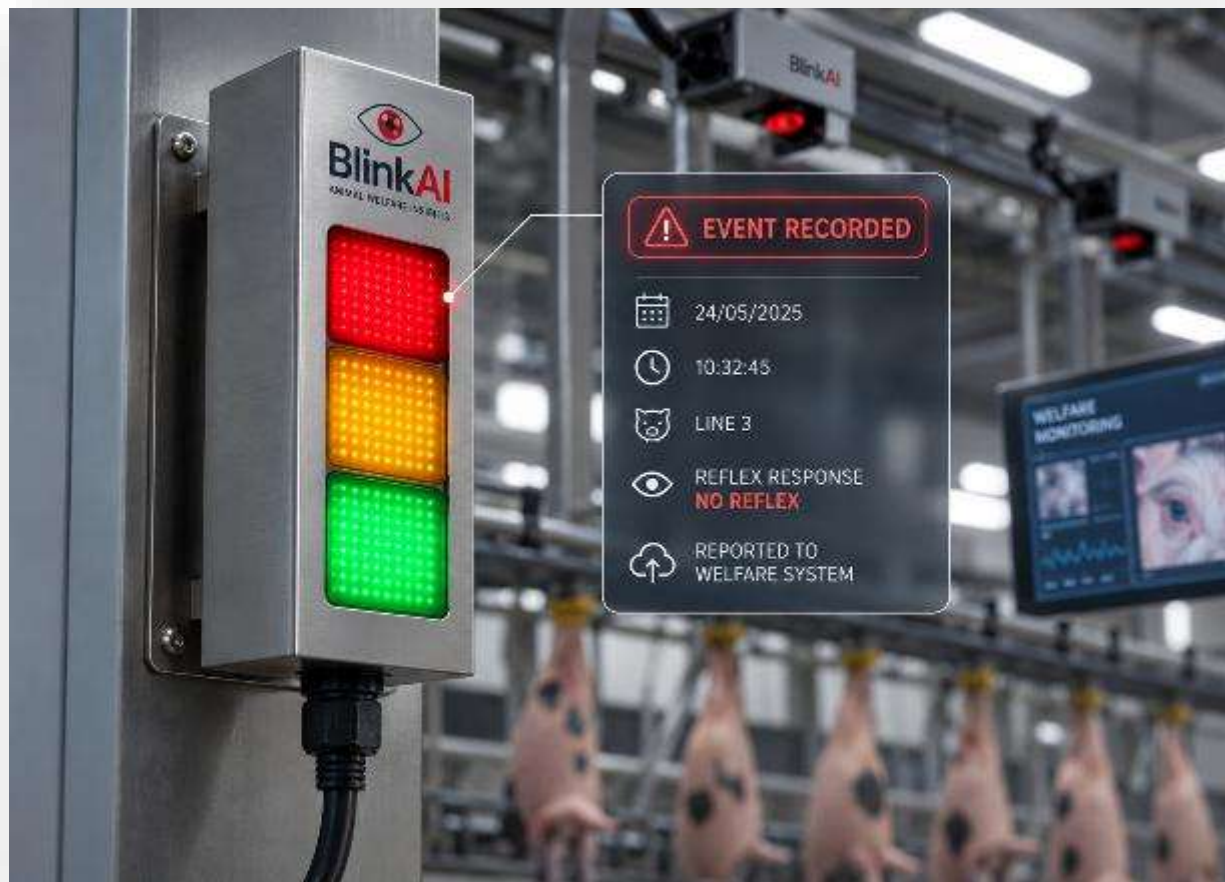
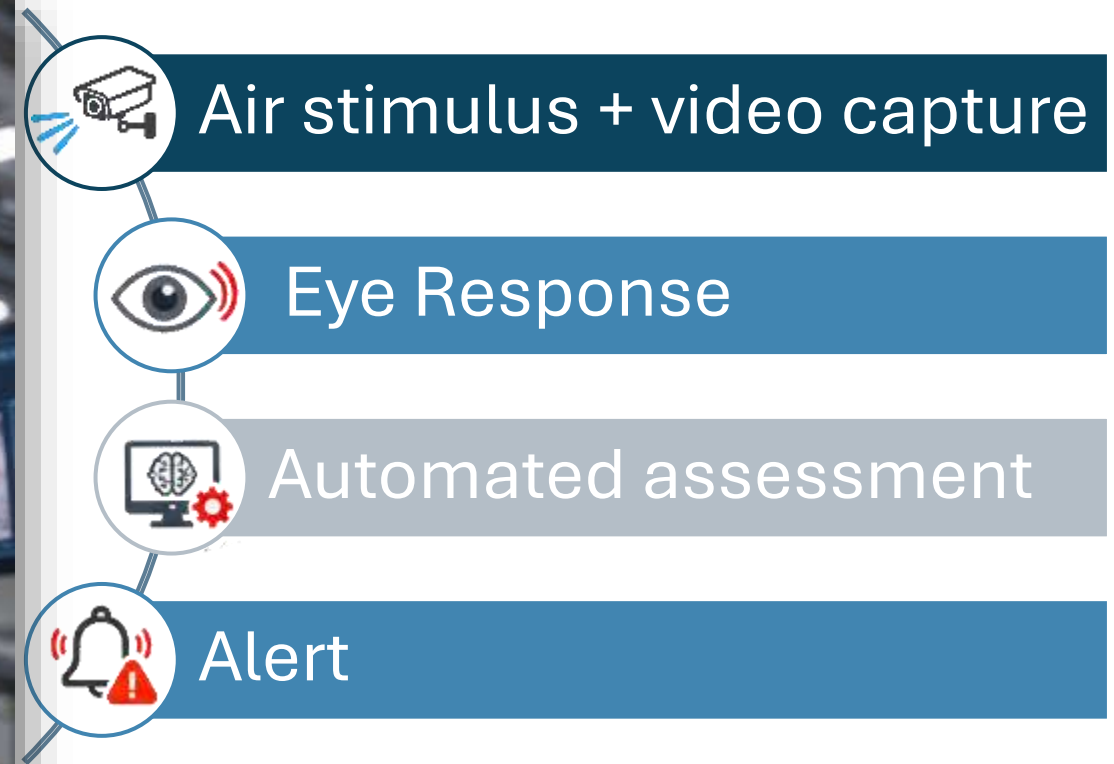
One of the first indicators to reappear during recovery

A positive reflex alone does not necessarily mean consciousness

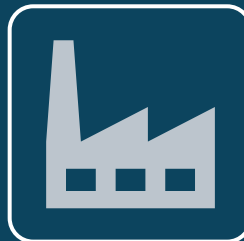


5 The BlinkAI idea

From corneal reflex check to automated monitoring



6 From idea to real installation

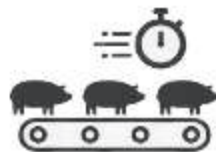


Selecció Batallé

aWISH pilot site



After CO₂ stunning



Commercial line

550 pigs/hour

7 How BlinkAI sees the animal



Head
detection

*Nose + both
eyes*



Eye
Localization

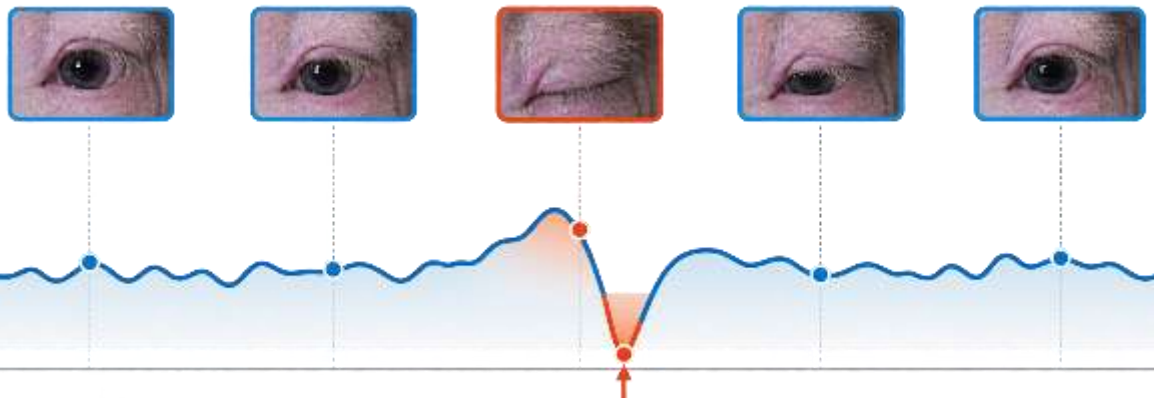


Eye tracking
across
sequence

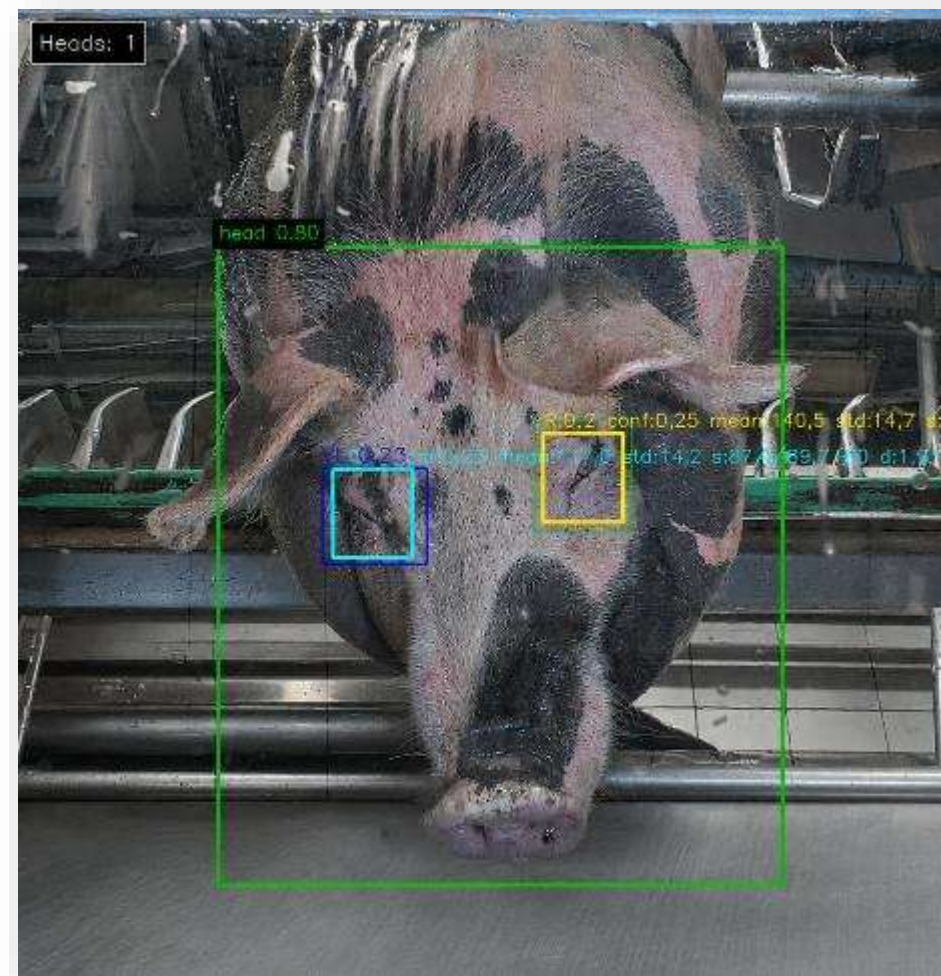


Blink-like
change

From image detection to temporal analysis



Temporal eye-change signal



8 A confirmed positive case



Expert-reviewed and confirmed

Reviewed by animal welfare experts



Compatible with a real blink response

The observed eye response is consistent with a corneal reflex



Confirmed under commercial conditions

Detected during normal slaughterhouse operation



A confirmed positive case shows that the system can identify the response it was designed to detect.



9 Results

- n = 3765 pigs
- 5 days
- Gold Standard = Corneal Reflex assessed by a human

Results	Gold standard	BlinkAI
Positive	30	68
Negative	3735	1684
Invalid	-	1943
Missing	-	70
Total	3765	3765

10 A slaughterhouse is not a laboratory



Movement

Water & dirt

Lighting changes

Angles

Optical artefacts

Temporary tracking loss

Robust tracking is the real challenge

11 What have we learned?



200,000+
automated
assessments



Few positive alerts



Alerts quality is high.

Only a small fraction of positive alerts required review.



Detections are accurate.

Most false positives are linked to operational artefacts.



We keep improving.

The dataset is driving ongoing refinement of tracking and blink detection.



Real-world data is driving **the next refinement cycle.**

12 The validation path

Technology validation

Tracking robustness

False alerts

Missed responses

Performance in commercial conditions

Method validation

Non-contact air stimulus

Relation with manual corneal reflex testing

Scientific interpretation of the response



From detecting the signal to proving reliability.

13 From checking animals to monitoring welfare



Can we monitor
stunning effectiveness
continuously?



Yes – but further **refinement** and **validation** is necessary



Continuous



Objective



Data-driven



A step towards **transparent animal welfare monitoring**



Thank you

Advancing animal welfare
with real-time insights

CONTACT (TECHNOLOGY)

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🔗 nunasolutions.com



BlinkAI

ANIMAL WELFARE INSIGHTS



UAB
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 **nuna**solutions



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TECHNOLOGY FOR A MORE SUSTAINABLE FOOD SYSTEM



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Stakeholder and consumer perspectives on animal welfare improvements in meat production

A. Kyriakidis^{1,2}, A.-N. Louvrou², C. Hauschildt², M. Ntovas², I. Kostopoulos², E. Altsitsiadis¹, A. Stamos¹

¹ Copenhagen Business School, DK · ² White Research SRL, BE

77th EAAP Annual Meeting · Hamburg

Session 94 · Thu 10 Sept 2026, 14:15 · Room Y3



Funded by
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From public concern to purchasing behaviour

- Animal welfare has become a policy priority (Farm to Fork, the EU Green Deal) and a near-consensus public concern.
- Yet higher-welfare meat stays niche. Concern does not automatically convert into purchases, and far less into **paying more**.
- The two parts of the problem are usually studied separately: what the **value chain** can deliver, and what **consumers** will accept.

This study looks at both sides and asks whether intending to buy and being willing to pay a premium are really the same behaviour.

Two studies across the farm-to-fork chain

STUDY 1 · VALUE CHAIN ACTORS

- **50** semi-structured interviews
- September 2023 – January 2024
- Regulators, farmers, catching teams, slaughterhouses, retail, vets, NGOs, scientists
- **LDA topic modelling + Falcon-180B LLM**

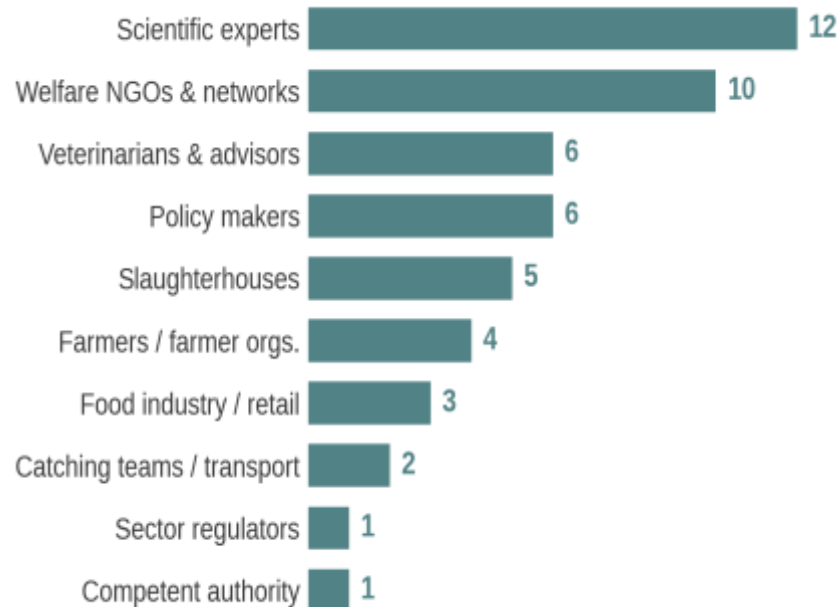
STUDY 2 · EU CONSUMERS

- **5,064** respondents across the EU
- April – May 2024, Prolific panel
- Two outcomes: purchase intention and willingness to pay a premium
- **PLS-SEM: TPB vs. VBN**

Study 1 · Stakeholder interviews

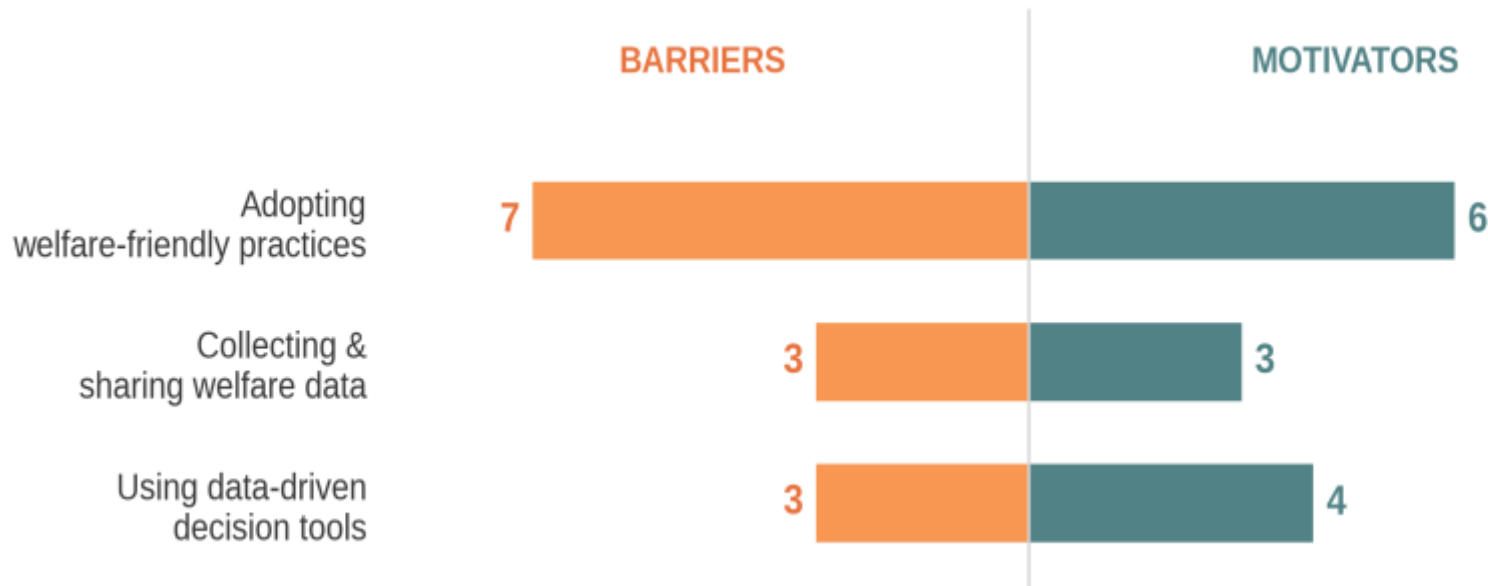
- 1 Anonymised, translated interview notes, 11 questions each
- 2 Preprocessing: normalise, tokenise, clean, remove stop-words, lemmatise
- 3 LDA in Gensim; topics per question set by maximising coherence over $k = 2-20$ — 12 to 19 per question
- 4 Falcon-180B interprets and categorises the topics into motivators and barriers

Ethics approval: Utrecht University, DGK S-23126



Interviewees by value-chain role (n = 50)

Motivators and barriers in three domains



Barriers outweigh motivators in exactly one domain
the one where money is actually spent.

What moves the value chain and what blocks it

MOTIVATORS

- Public awareness of animal welfare
- Financial benefit from higher-welfare products
- Certification schemes
- Strong, enforced regulation
- Training and education
- Consumers' willingness to pay

BARRIERS

- Financial constraints
- Lack of awareness and education
- Price sensitivity — cheaper products win
- Operational difficulty on farm and at slaughter
- Rules that differ across countries
- Low market demand; welfare misconceptions



Study 2 · EU Consumer Survey

- **5,064** valid responses (5,149 screened); meat consumers,
- Prolific panel, April – May 2024; mean age 30.7 (SD 9.5)
- PLS-SEM, 10,000 bootstrap samples, BCa confidence intervals
- CVPAT with 10 folds × 10 repetitions; controls for age, gender, education, income

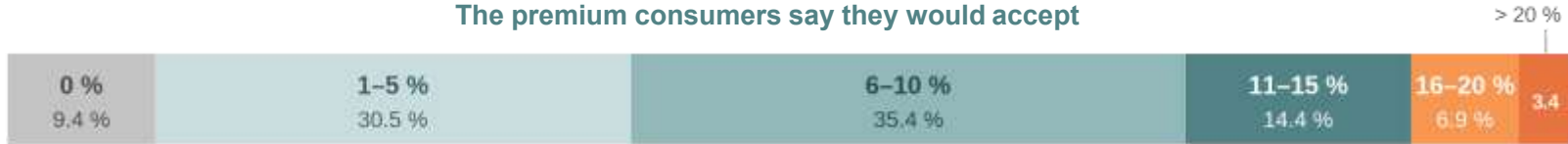
TPB — the rational path

attitudes · subjective norms · perceived behavioural control

VBN — the moral path

values → ecological worldview → awareness
→ responsibility → personal norms

The premium consumers say they would accept



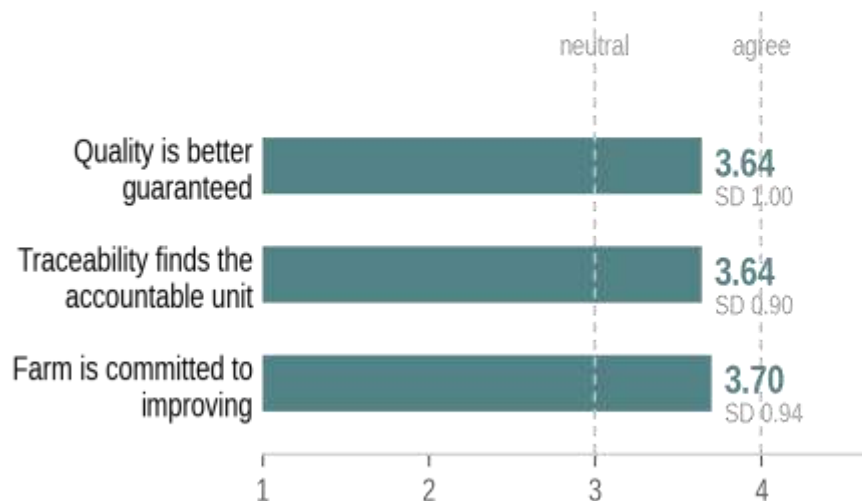
Nine in ten would pay something — but only one in four would go above 10 %



Trust in certification: moderate, and flat

Three trust items (1 = strongly disagree, 5 = strongly agree)

... and it barely moves by segment

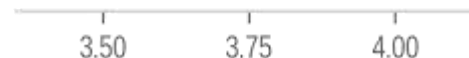


Age (18-24 → 55-64) 3.61 – 3.87

Gender (male / female) 3.54 – 3.82

Education 3.60 – 3.69

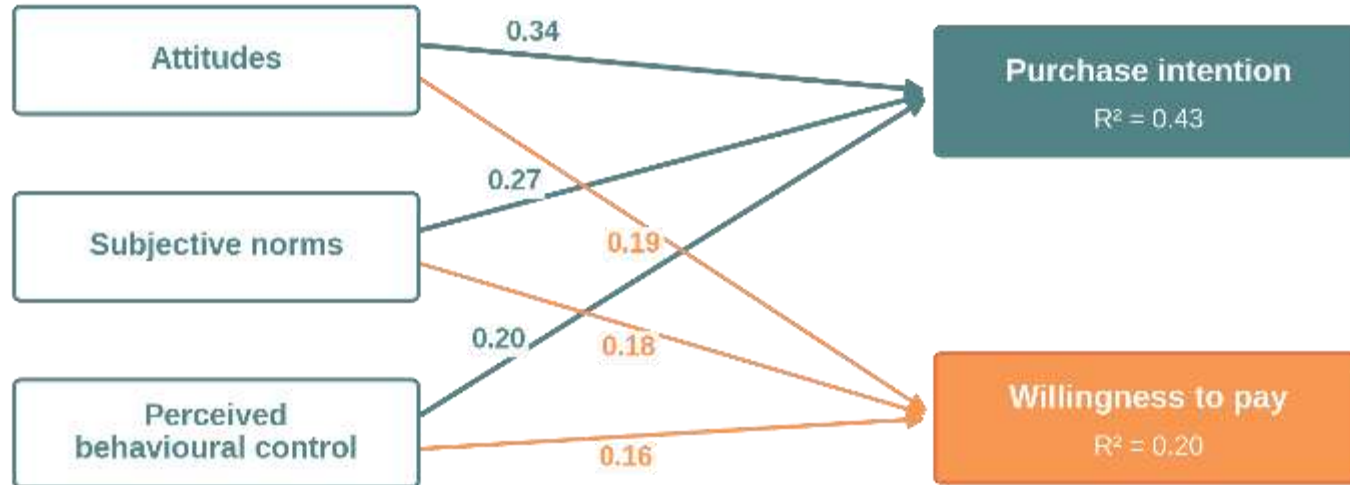
Income 3.58 – 3.70



Certification is the value chain's named lever, but consumers sit barely above neutral on it, and no segment sits meaningfully higher. **This is a ceiling, not a targeting problem.**



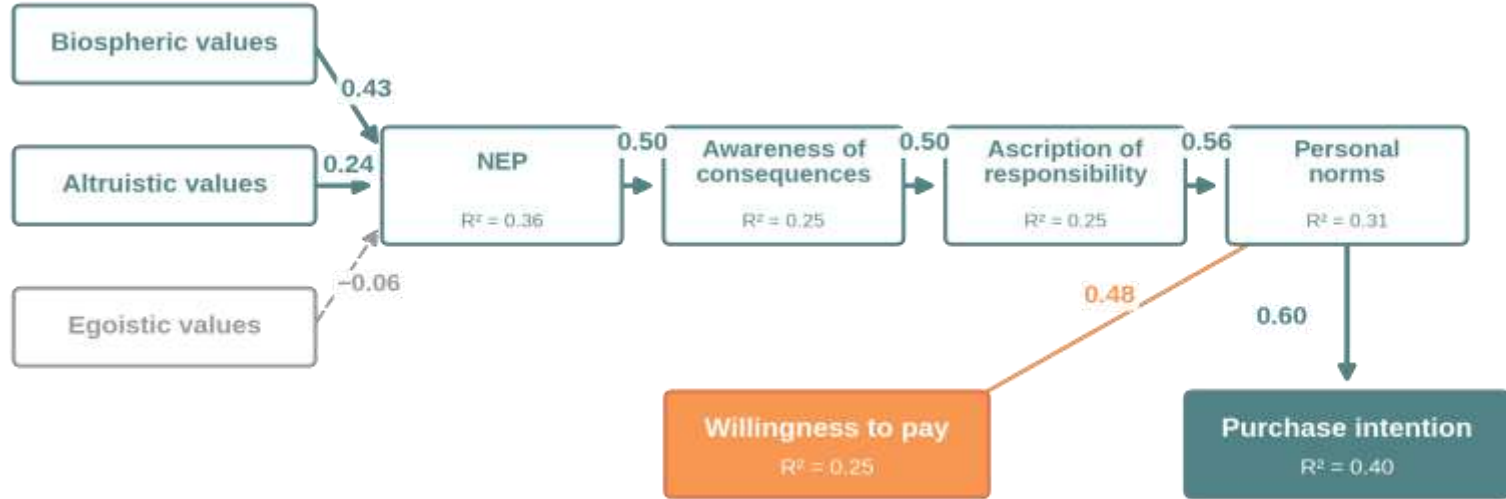
TPB explains better what people intend to do



All paths $p < 0.001$ • $n = 5,064$ • controls: age, gender, education, income

Attitudes dominate ($\beta = 0.34$). The same three predictors explain intention well, but explain paying a premium less.

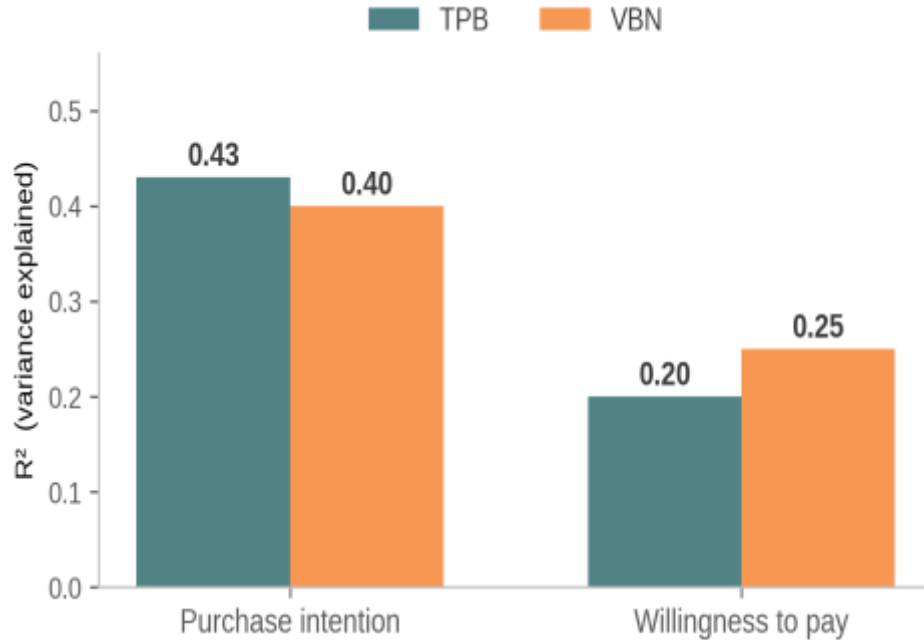
VBN explains better what people are willing to pay



All paths $p < 0.001$ • $n = 5,064$ • controls: age, gender, education, income

The whole chain holds. Personal norms are the strongest single lever in either model, with $\beta = 0.60$ on intention and $\beta = 0.48$ on willingness to pay.

Different outcomes – different theories



TPB → Purchase intention

R^2 0.43 vs 0.40 · Q^2 0.41 vs 0.07
BIC -2752 vs -2546 · Akaike $w = 1$

VBN → Willingness to pay

R^2 0.25 vs 0.20 · Akaike $w = 1$
BIC -1363 vs -1017 (lower = better fit)

Where the two studies meet

VALUE CHAIN · 50 interviews

EU CONSUMERS · n = 5,064

TOGETHER

Awareness & education

The top motivator, and its absence
the top barrier to adoption

Attitudes are the strongest driver of
intention ($\beta = 0.34$)

**Awareness work converts
into intention**

Certification & labelling

Named a key motivator; asked to
be harmonised and credible

Trust in labels only 3.64 – 3.70
out of 5

**Credibility is the bottleneck,
not the label**

Price & premium

Financial constraints are the
single biggest barrier

Premium acceptance runs on
personal norms ($\beta = 0.48$), not
attitudes

**The premium is winnable, if
approached morally**



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Two frameworks for expert-based livestock welfare scoring: a comparative analysis

Simon Verlinde^{1,2}, Björn Forkman³, Frank Tuytens¹, Pol Llonch⁴,
Bas Rodenburg⁵, Jan Verwaeren², Jarissa Maselyne¹

¹ILVO, Belgium

²Gent University, Belgium

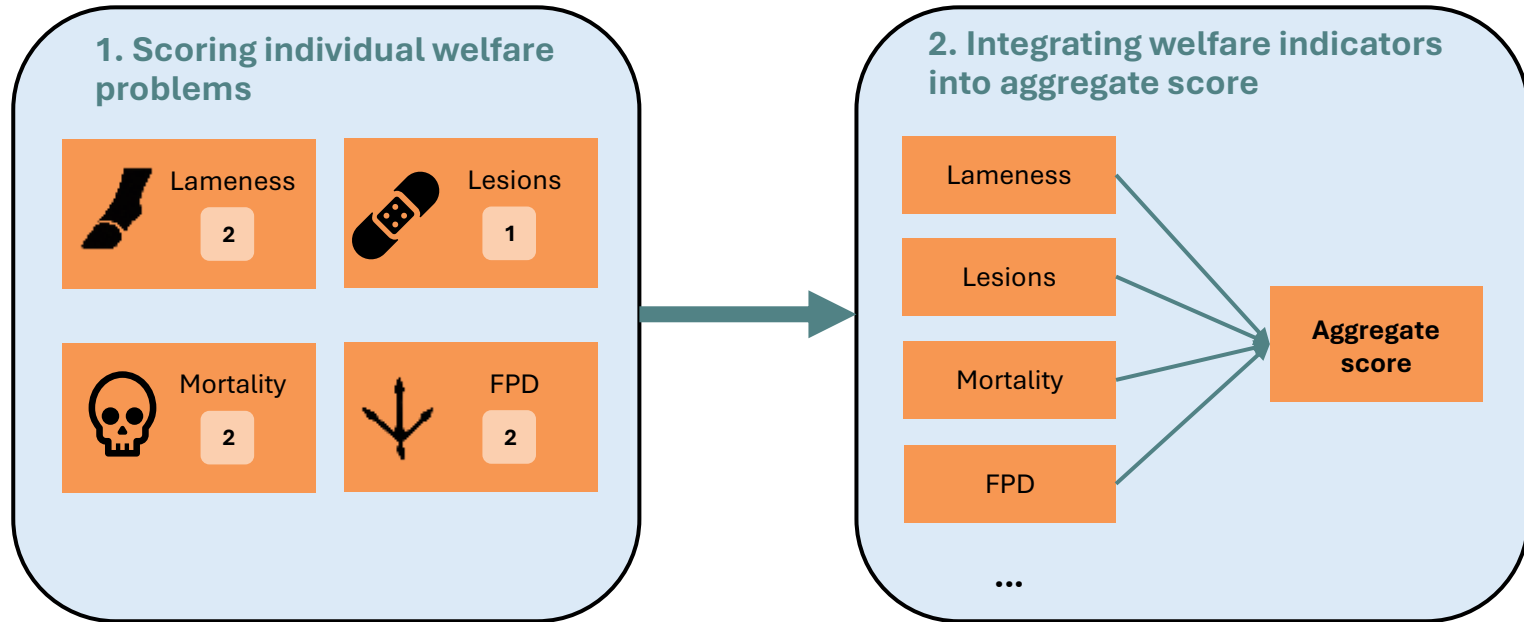
³University of Copenhagen, Denmark

⁴Autonomous University of Barcelona, Spain

⁵Utrecht University, Netherlands

Introduction

Quantifying general herd welfare is a two-step process



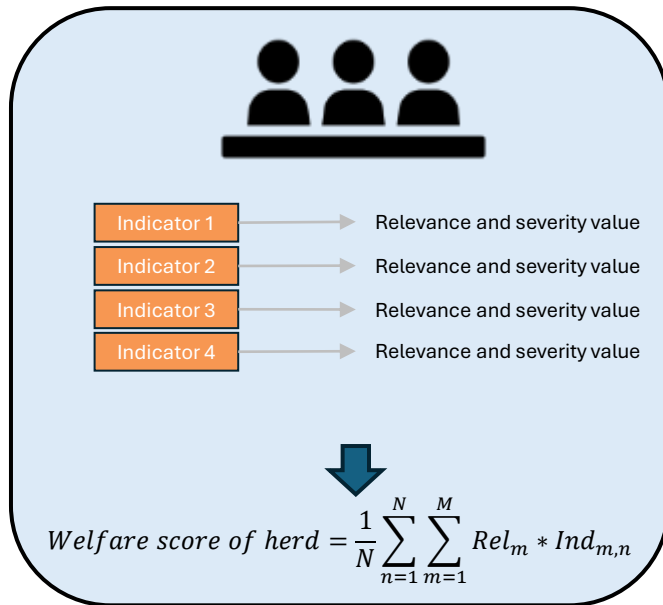
How should multiple indicators integrated into one score?

Goal

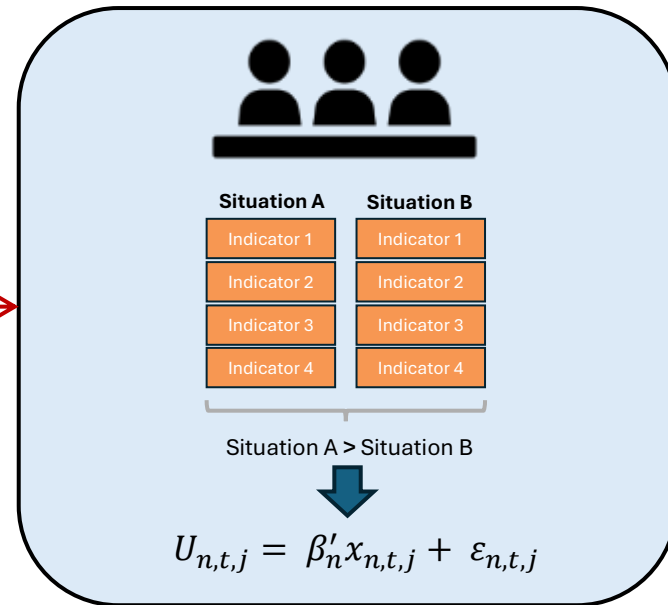
Quantifying group welfare:

1. Absolute evaluation = Indicator-based approach
2. Relative evaluation = Situation-based approach

Indicator-based evaluation



Situation-based evaluation



How consistent are welfare experts?



Selected indicators

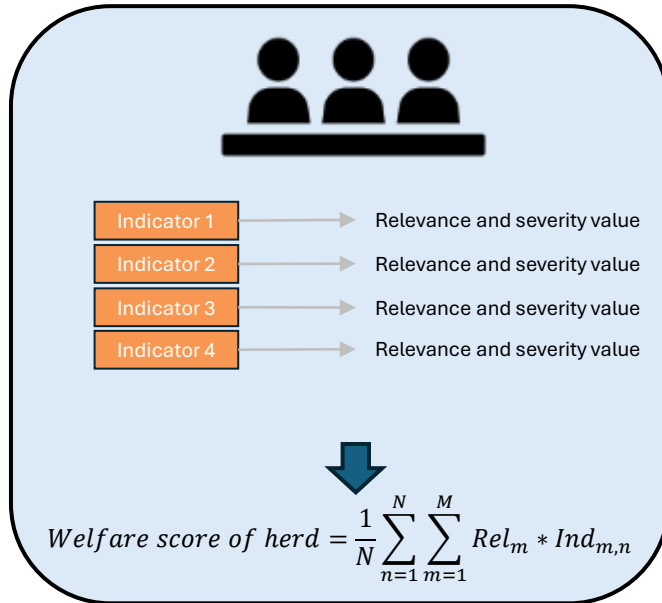
Selection criteria:

1. Animal-based welfare indicators
2. Routine or automated capture at slaughterhouse (+supplementary AWI)
3. Validity

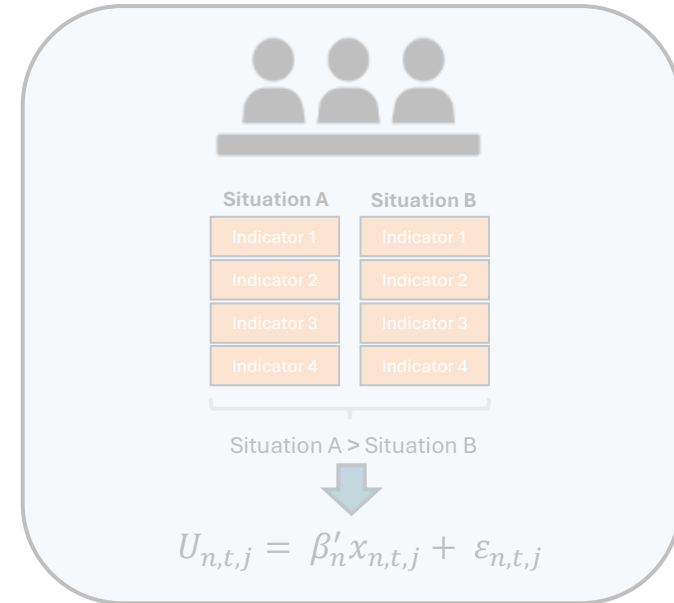
Broilers	Pigs
<i>Gait score</i>	<i>Lameness</i>
<i>Dead on farm/culling</i>	<i>Bursitis</i>
<i>Footpad dermatitis</i>	<i>Pneumonia</i>
<i>Hock burn</i>	<i>Pleurisy</i>
<i>Slaughterhouse rejections</i>	<i>Rectal prolapse</i>
<i>Bruising</i>	<i>Tail lesions</i>
<i>Skin lesions and integument damage</i>	<i>Tail length</i>
<i>Dead on arrival</i>	<i>Ear lesions</i>
<i>Dislocations & fractures</i>	<i>Skin lesions</i>
<i>Stunning failure</i>	<i>Dead on arrival</i>
<i>Uneven flock distribution</i>	<i>Corneal reflex after stunning</i>
	<i>Hernia</i>

Indicator-based approach: Survey

Indicator-based evaluation



Situation-based evaluation



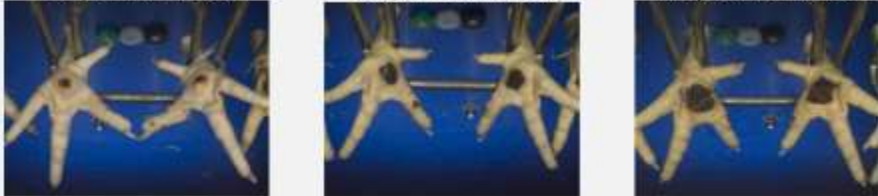
Indicator-based approach: Survey

Online survey structure

- 11-12 indicators considered
- Individual level
- Responses = 0-100 scores:
 - Impact on individual welfare
 - Relevance
 - *Certainty of expert answers*

This is footpad dermatitis (FPD). How would you score the different severity levels of FPD between 0 (no negative welfare consequence) and 100 (maximal negative consequence).

Footpad dermatitis 1 **Footpad dermatitis 2** **Footpad dermatitis 3**



FPD 1

0 100

FPD 2

0 100

FPD 3

0 100

How relevant is FPD as a welfare indicator:

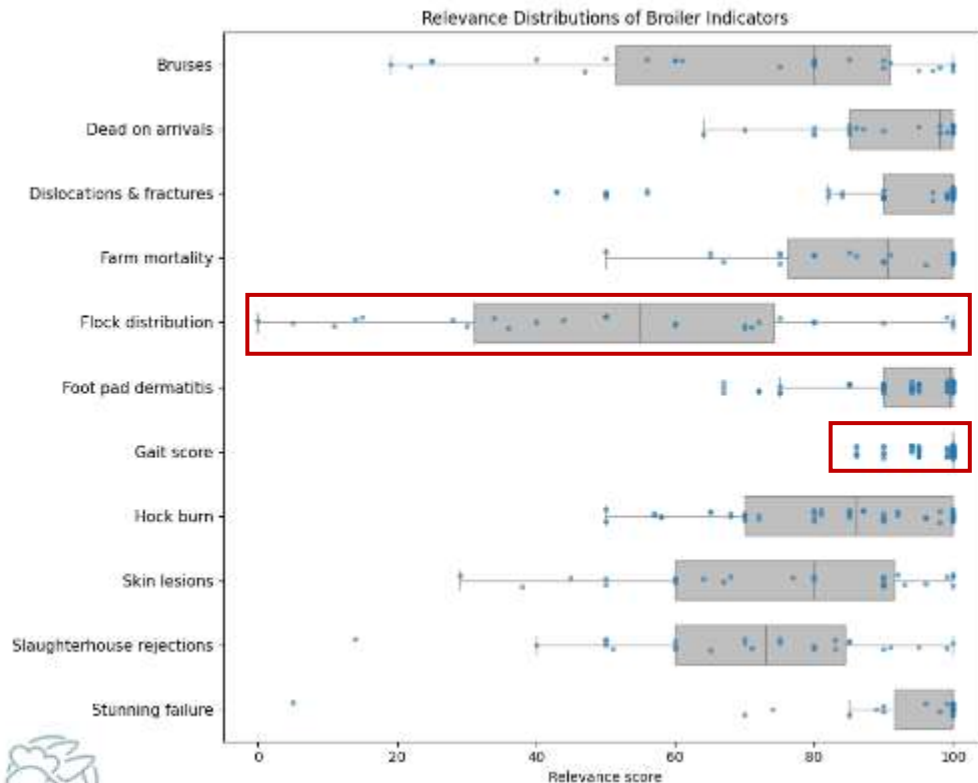
0 100

How certain are you of your answer taking your background knowledge into account

0 100

Indicator-based approach: Results

Indicator relevancy responses



Inter-expert Agreement	Nb of experts	ICC(3,1)
Broiler survey	26	0,37
Pig survey	24	0.31

Two-way mixed-effects model ICC(3,1)

= consistency in ranking indicators

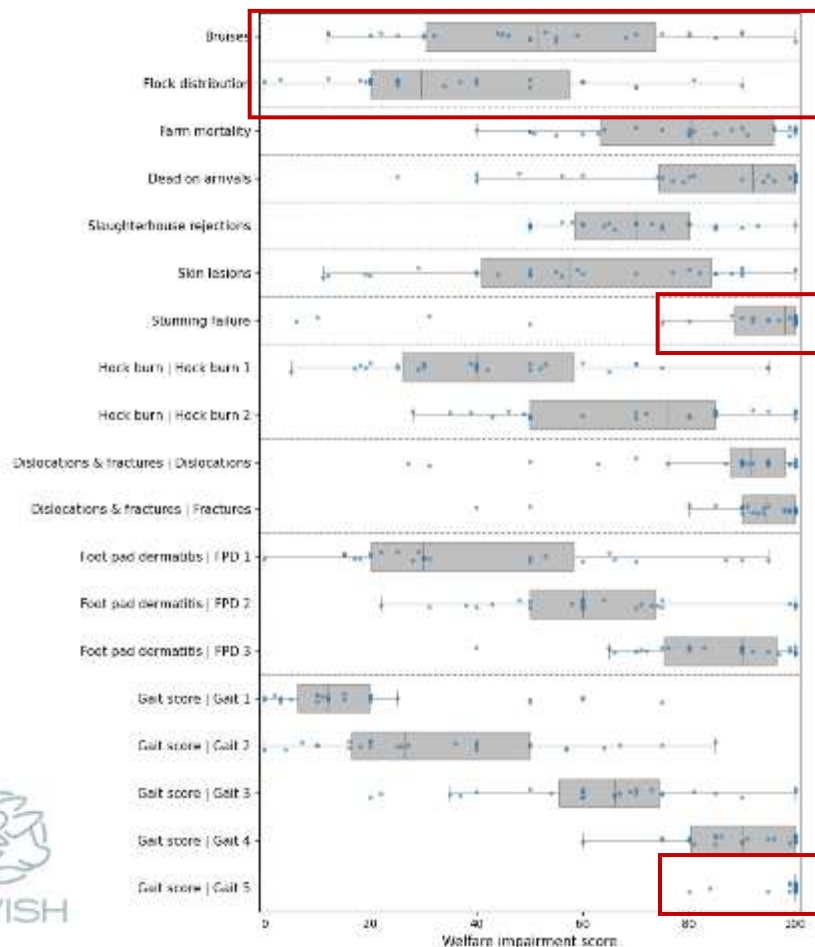
< 0.5: Poor agreement

0.5-0.75: Moderate agreement

0.75-0.90: Good agreement

> 0.9: Excellent agreement

Indicator-based approach: Results



Indicator severity responses

Inter-expert Agreement	Nb of experts	ICC(3,1)
Broiler survey	26	0.59
Pig survey	24	0.46

Two-way mixed-effects model ICC(3,1)

= consistency in ranking indicators

< 0.5: Poor agreement

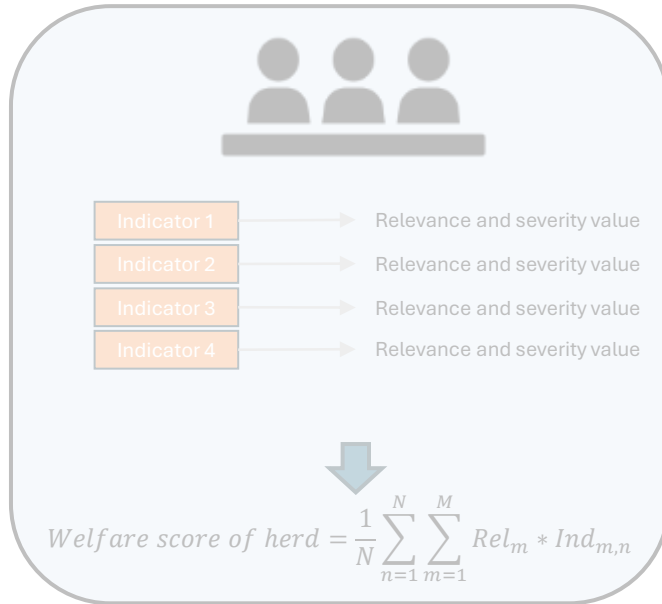
0.5-0.75: Moderate agreement

0.75-0.90: Good agreement

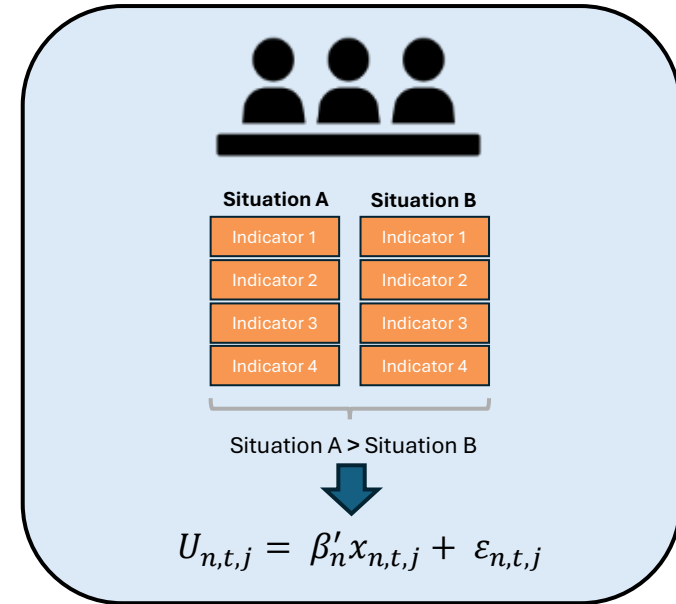
> 0.9: Excellent agreement

Situation-based approach: Survey

Indicator-based evaluation



Situation-based evaluation



Situation-based approach: Survey

Situation-based approach (=Discrete choice experiment)

- 11 indicators
- 3-4 levels

Nb possible pair-wise comparisons = $>10^8$

Selecting 'informative' decisions (≈ 1 decision/min):

- Random sampling: hard decisions $>$ easy decisions
 - Bayesian D-efficient design with partial profiles:
 - $\Rightarrow$ Prior information (i.e. Responses previous survey)
 - $\Rightarrow$ 3-7 indicators considered at the same time
- $\Rightarrow$ Blocked design with 30 blocks of 10 tasks (300 choice sets)

Situation-based approach: Survey

Online survey structure

- 3 sets of 10 questions
- Group level evaluation
- Responses:
 - Preference
 - *Perceived difference (0-100)*

Which welfare situation is better overall?

Indicator	Situation A	Situation B
Hock Burn	2	1
Slaughterhouse rejections	0.40%	1.5%
Footpad dermatitis	2	3
Dead on Arrival (DOA)	0.02%	0.10%
Dislocations & Fractures	0.10%	0.20%
Gait score	3.5	2.5
Farm mortality	10.0%	5.0%

Choose one of the following answers::

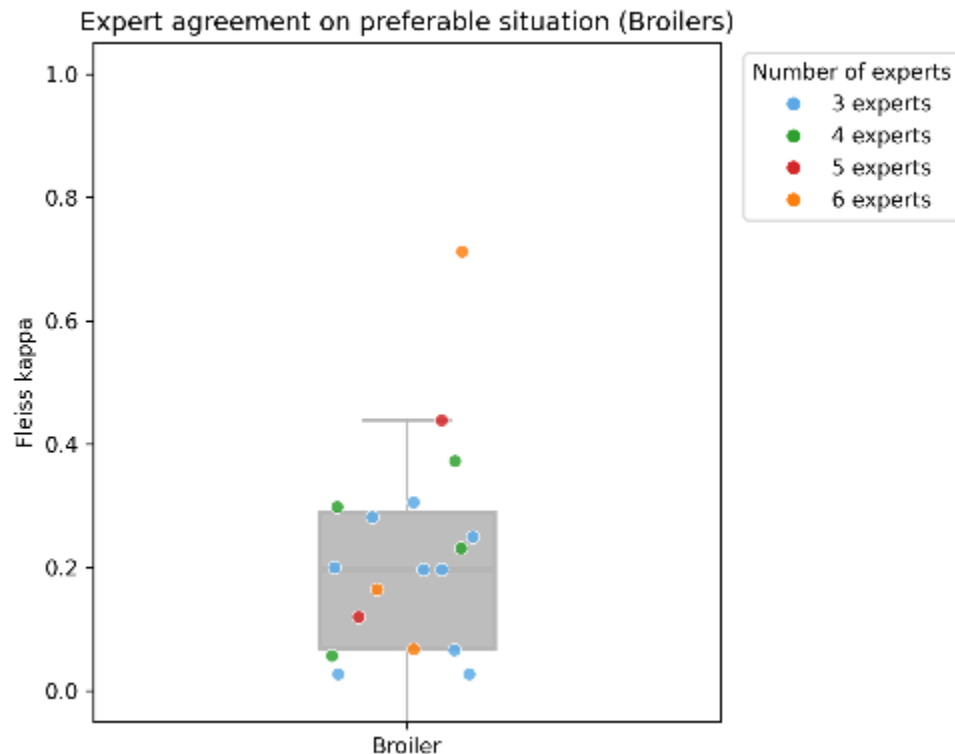
- ☐ Situation A
- ☐ Situation B

Please rate the magnitude of the welfare difference on a 0-100 scale (0 = equal welfare, 100 = extremely large difference)

0 100

Situation-based approach: Results

Expert responses: Preference of situation



Inter-expert Agreement	Nb of experts	Median Fleiss Kappa
Broiler survey	35	0.19
Pig survey	37	0.42

Fleiss' Kappa

= *Chance corrected agreement*

< 0: Poor agreement

0.01-0.20: Slight agreement

0.21-0.40: Fair agreement

0.41-0.60: Moderate agreement

0.61-0.80: Substantial agreement

0.81-1.00: Almost perfect agreement

Situation-based approach: Results

Survey-related causes for low expert agreement?

1) High difficulty of task

=> Let experts repeat the same task

Fleiss Kappa	Inter-expert agreement	Intra-expert agreement
Broiler experts	0.19	0.52
Pig experts	0.42	0.71

2) Number of presented indicators:

=> Evaluate reliability ~ Nb of indicators

Krippendorff agreement	4 indicators	5 indicators	6 indicators	7 indicators
Broiler experts	0.29	0.05	0.33	0.31
Pig experts	0.50	0.42	0.36	0.48

But questions were designed to be **'border' cases!**

Conclusion & future steps

Varying agreement in both approaches

1. Indicator-based approach:
 - Indicators considered in isolation
 - Low-moderate agreement between experts
2. Situation-based approach:
 - More realistic evaluations
 - Low agreement between experts

=> What is the value of an aggregate model if there is little agreement?

Future steps:

- Simulate situation answers using indicator data



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Thank you for your attention!

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Economic impact of enhanced pig welfare systems on Austrian finishing farms using information from automated monitoring

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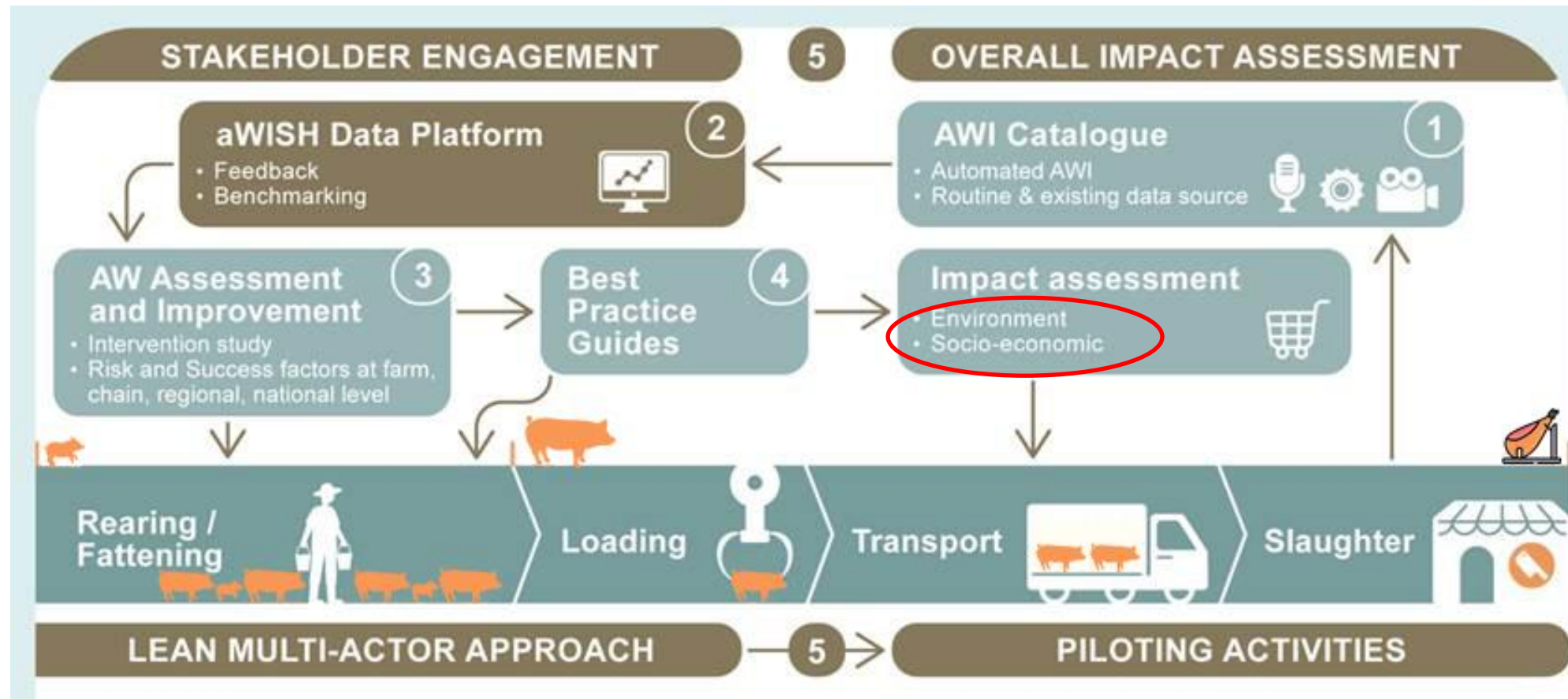
10th September, 2026



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- **Tail lesions** and **tail length** are **key animal-based indicators** of management deficiencies associated with tail-biting.
- **Tail-biting** is a **multifactorial behavioral disorder** driven by **internal** and **external factors**.
- The ban on routine tail-docking and the focus on preventative measures to reduce tail-biting were introduced in 1991 in the EU Pig Directive (91/630/ECC), which was amended in 2008 (2008/120/EC).
- Routine tail-docking is still permitted in the European Union; however, there are **several animal welfare programs at EU level** (as in Austria), or slaughterhouses pay premiums for higher animal welfare standards, often involves **pigs with intact tails**.
- Intact tails will indicate better welfare and husbandry and qualify for premium welfare labels, increasing market prices potential by 10 – 30%.
- **Challenges remain:** Without interventions (e.g., straw racks or increased space), pigs with intact-tails show 15–50 % **higher tail lesion prevalence at slaughter**, leading to increased veterinary costs, mortality, and reduced carcass value (*Valros et al., 2020*).





Best Practices Schwein

Schwanzbeißen

Welche kurzfristigen Maßnahmen empfehlen Sie zur Vorbeugung von Schwanzbeißen?
z. B. Beschäftigungsmaterial anbieten

mehr Infomaterial, Fortbildungen etc.
zu Tierperspektive
↳ warum macht das Schwein das?
Notfallkoffer (Raukitt, etc.)
Austausch (4-Augen-Prinzip)

Welche langfristigen Maßnahmen empfehlen Sie zur Vorbeugung von Schwanzbeißen?
z. B. Strukturierung der Buchten

Transparenz & Wertschätzung
↳ der Ringschwein muss sich lohnen!
guter Gesundheitszustand
Genetik
Fütterung & Wasser
Fortbildungen
niederschwelliger Zugang
↳ auch für kleine Schweine

Welche Maßnahmen empfehlen Sie bei einem akuten Ausbruch von Schwanzbeißen?

Täter finden & raus
Schwänze versorgen
Stress aus der Gruppe kriegen
Beschäftigungsmaterial
Fütterungsriten & Tränken überprüfen

Schwanzverletzungen

Stichwort: Stress
Hautverletzungen

Welche kurzfristigen Maßnahmen empfehlen Sie zur Vorbeugung von Hautverletzungen?
z. B. scharfe Kanten entfernen

Sortieren in Ruhe bevor der LKW kommt (z.B. am Abend vorher)
Schlagen vom Transport
Gitter abdichten (z.B. durch Bretter)

Welche langfristigen Maßnahmen empfehlen Sie zur Vorbeugung von Hautverletzungen?
z. B. geringere Besatzdichten

auf Spurensuche gehen

Treten Hautverletzungen Ihrer Meinung nach eher im Betrieb (z. B. durch Rankämpfe) oder beim Transport zum Schlachthof auf?

Was wünschen Sie sich von einem "Best Practice Guide" für die Schweinehaltung? Welche Informationen dürfen nicht fehlen?

Kupferverzicht braucht Gefühl
Anreize schaffen → es muss sich rechnen
Messbar am Schlachthof

Source: MM Jachens, 2026

aWish Stakeholder Workshop – „Best practices in Pig Farming“

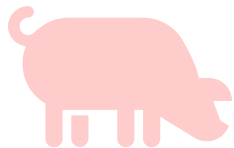
- Keeping pigs with intact tails will generate additional costs
- Farmers expressed a need of financial incentives to bear the implementation of this measure



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Objective

Socio-economic assessment of additional costs of participating in the “Mehr Tierwohl – sehr gut” Program” on the example of Austrian aWish Pig Pilot farms





- **Three representative average farms** (small, medium, large) were constructed from the baseline data collected on 6 pilot farms in 2024 to protect data confidentiality.
- **Practice change analysis** applied on the example of **two Austrian animal welfare promoting husbandry systems**: 'Mehr Tierwohl – gut' (TW60) and 'Mehr Tierwohl – sehr gut' (TW100).
- Data on the '**Mehr Tierwohl – sehr gut**' (TW100) were obtained from a farmer (online interview) implementing this system. Percentage changes in key indicators were applied to the representative farms.
- The '**Mehr Tierwohl – gut**' (TW60) **scenario** was modelled to capture intermediate animal-welfare requirements and to better understand how these different requirements affect production costs and profits.
- For practice change analysis the **TIPI-CAL model** was used.



Material and Methods

What is TIPI-CAL?

TIPI-CAL is a simulation model

[**T**echnology **I**mpact and **P**olicy **I**mpact **C**alculations]

- ✓ Production and accounting model
- ✓ Whole farm level and enterprise level
- ✓ Excel-Spreadsheet
- ✓ Pure simulation without algorithms or optimisation
- ✓ Deterministic or stochastic, recursive
- ✓ 'Shareware' for *agri benchmark* partners and clients
- ✓ Basic model and additional modules for cost analysis and data management



Material and Methods

Animal welfare standard	Pig weight (kg)	Space (m ²)	Lying area (m ²)	Additional requirements
Mehr Tierwohl sehr gut (TW 100) – Animal welfare very good	> 50	0.8	0.4	1. 100% more space
				2. Bedded, soft lying area
				3. Manipulable materials
	50 - 85	1.1	0.5	4. Undocked tails
	85 - 110	1.4	0.6	5. Outside area/ exterior climate area
	>110	2	0.8	6. GMO-free feed
				7. Castration with anesthesia
				8. Scratching facilities
Mehr Tierwohl gut (TW 60)– Animal welfare good	> 50	0.7	0.28	1. 60% more space (indoors/ including outside area)
				2. Bedded lying area
				3. Enrichment material – straw/hay
				4. partial intact tails allowed



No. of pigs sold per year based on management system

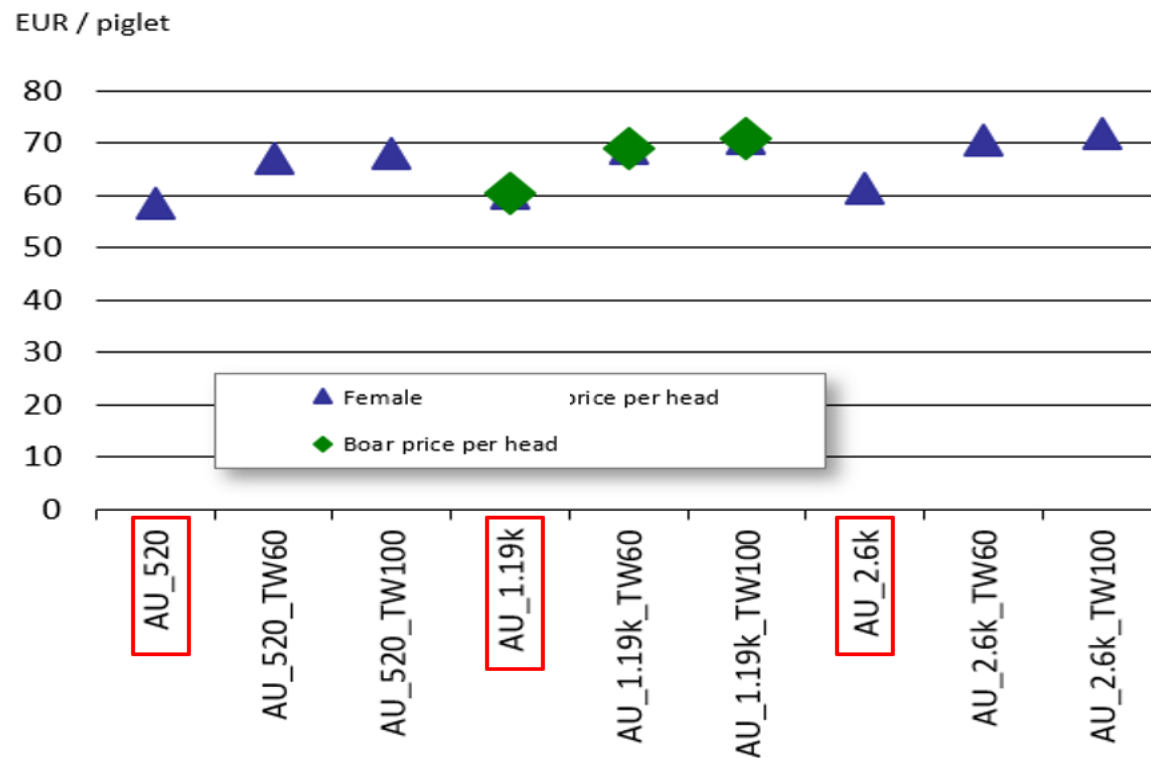
No. of pigs (Baseline)	Live weight at slaughter (kg)	Stocking density/m ² (standard requirement)	Stocking density/m ² (TW 60)	Stocking density/m ² (TW 100)	No. of pigs (TW 60)	No. of pigs (TW 100)
520	95	0.7	1.1	1.4	378	297
1190	95.5	0.7	1.1	1.4	865	680
2600	110	0.7	1.1	1.4	1891	1486

Source: Own illustration based on data analysis.

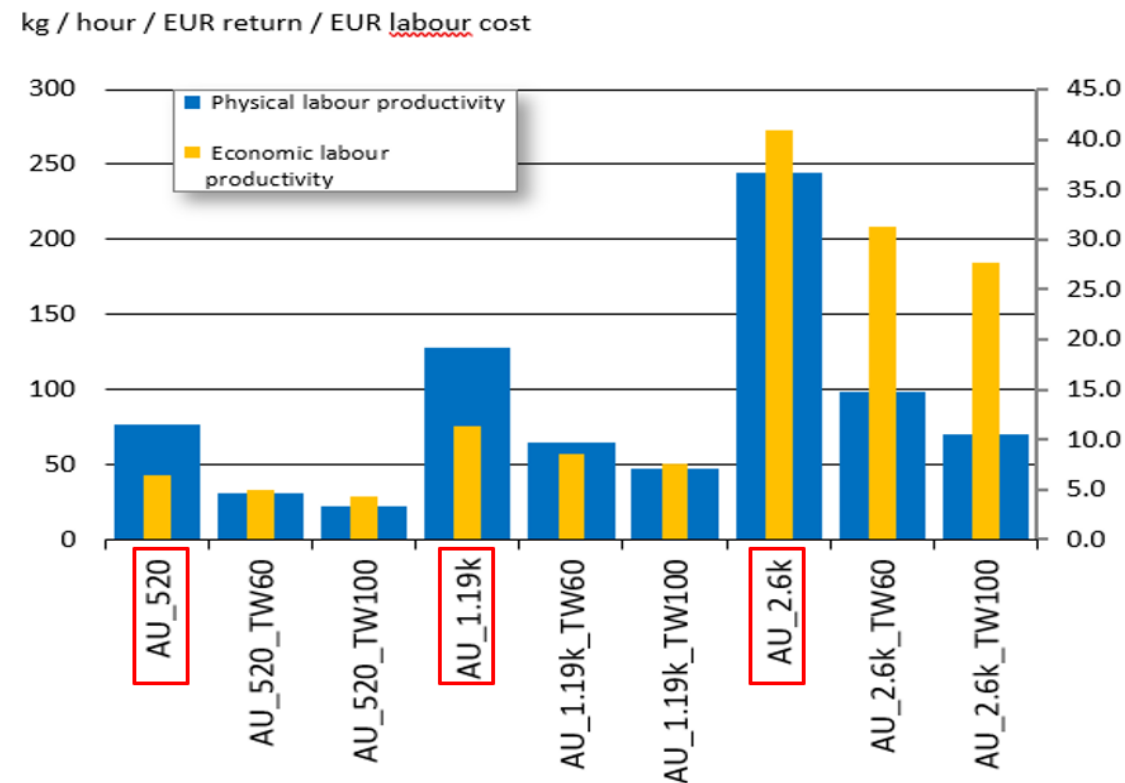
- Three representative average farms (small, medium, large) were constructed.
- We grouped the pilot farms based on the number of pigs per farm and calculated the average.
- These farms sell their pigs at a finishing weight of 95 kg, 95,5 kg and 110 kg, falling into the same spacing requirements (TW 60, TW 100).



Piglet price per head



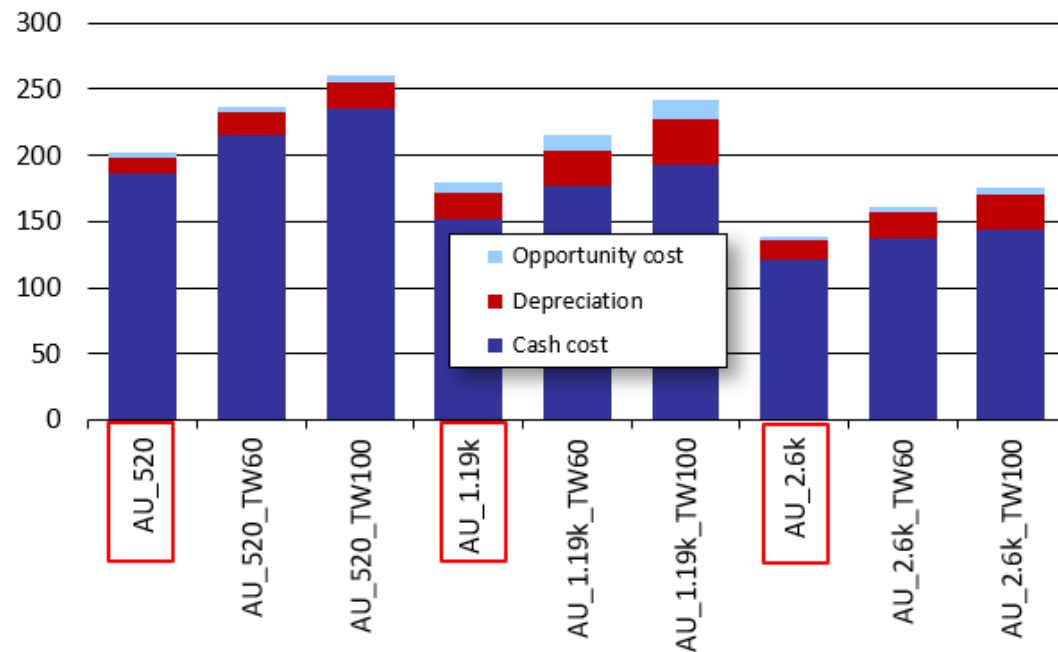
Physical and economic labour productivity





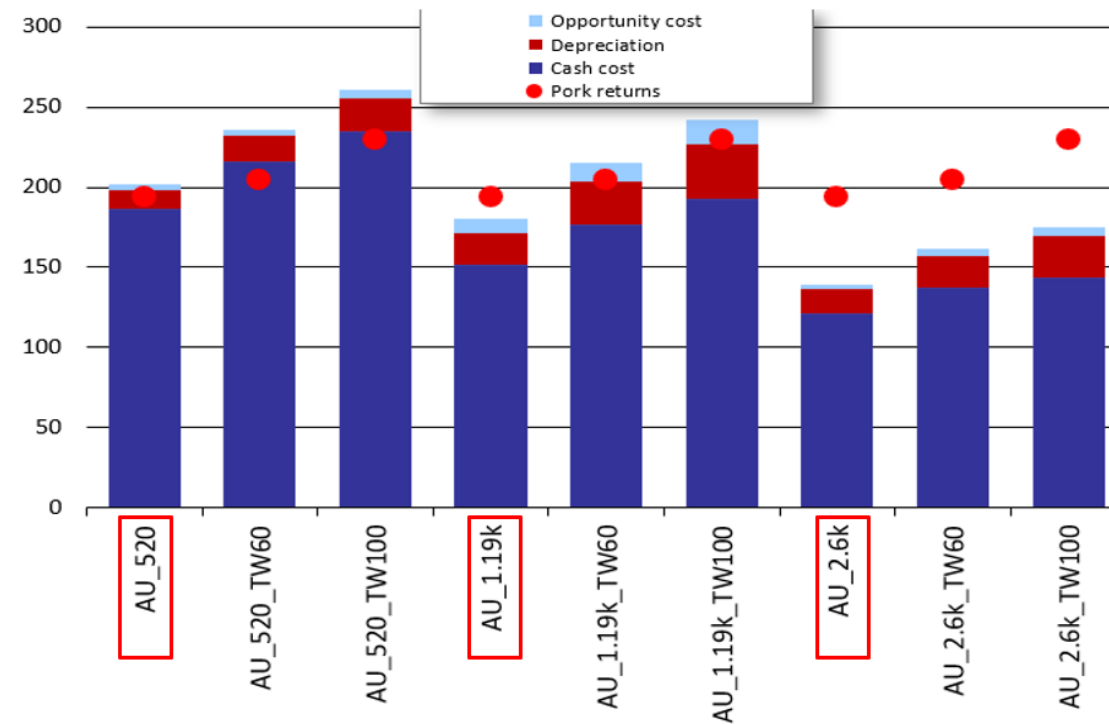
Total cost of the pig enterprise by cash and non-Cash cost - absolute values

EUR / 100 kg CW



Returns and profitability

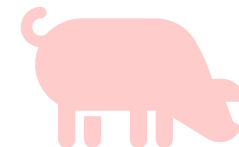
EUR / 100 kg CW





Conclusions & Outlook

- The adoption of higher animal welfare standards increases labour requirements, reduces labour efficiency, and raises production costs, particularly on small farms.
- Larger farms are better able to absorb these additional costs due to economies of scale.
- The adoption of higher welfare standards should be supported through price premiums, targeted policy incentives or investment support, especially for small and medium-sized farms, to improve economic sustainability.
- The **PigInspector** could be a **PLF-tool** to monitor animal welfare indicators at the slaughterhouse e.g. tail length (cm), ear- and tail necrosis.





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[aWISH – Animal Welfare Indicators at the
Slaughterhouse \(awish-project.eu\)](http://awish-project.eu)



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Utrecht
University



How to evaluate animal welfare improving initiatives on regional and national level?

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Background

- EU: minimum welfare standards for animals on farms (Council Directive 98/58/EC 1998)
- In addition: animal welfare improving initiatives (AWII)
 - Often exceed minimum legal requirements
 - Implemented by different operators and at different levels



- Private operator
- Regional level



- Groups of private operators
- Regional, national or international level



- Public operators
- Regional, national or international level

Background

- Impact of AWII in practice is hard to determine
- Animal welfare assessments, including animal-based data
- For farmed animals: data collection at the slaughterhouse



- Large number of animals from different farms
- Less time, costs
- Reduced risk of disease transmission



- Animals who are euthanized or die on the farm
- Interventions only benefit future animals

Aim



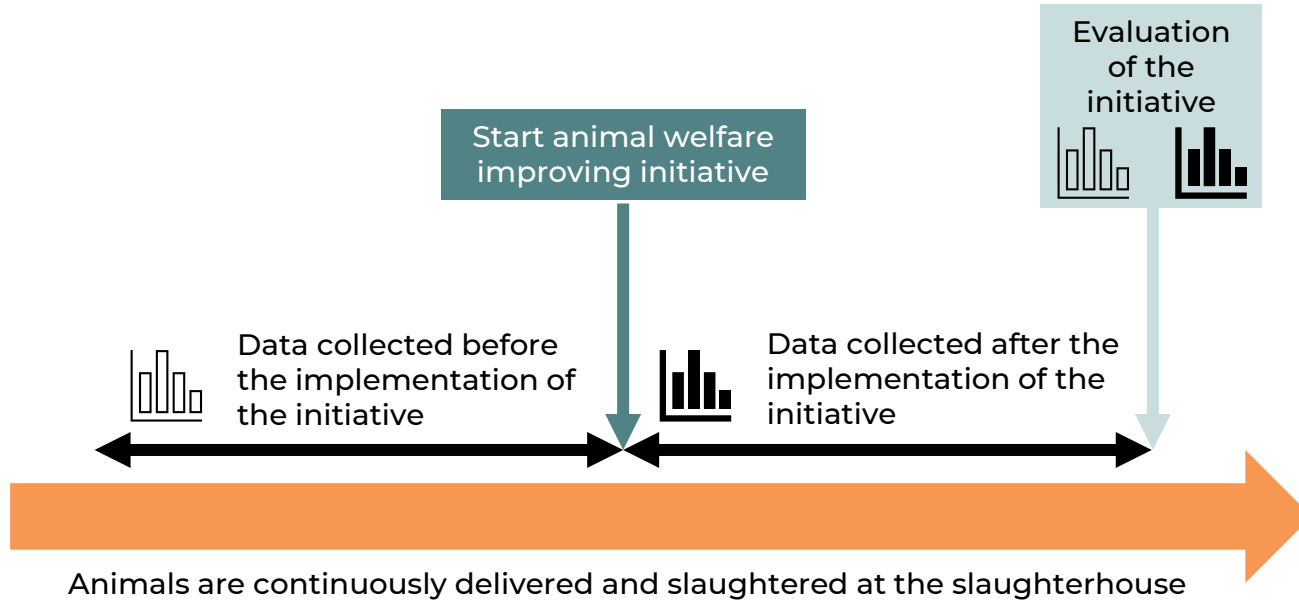
- Identify AWII for pigs and broilers on regional and national level
- Evaluate their effects on animal welfare
 - Based on data collected at the aWish pilot slaughterhouses
 - By comparing data from before – after implementation of the AWII
 - By comparing different groups of operators
 - By comparing data with historical records from national data repositories



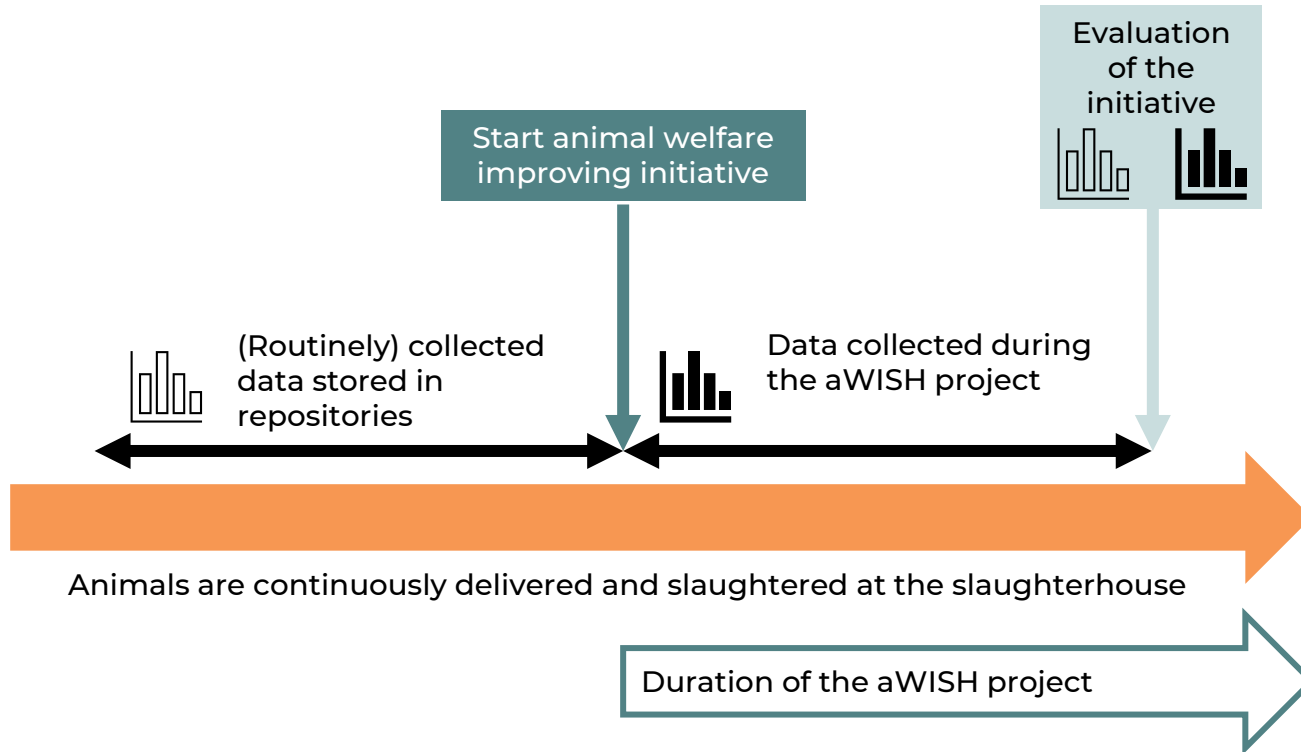
- Systematic approach for the evaluation of AWII based on data collected at the slaughterhouse
- Example of the aWISH project



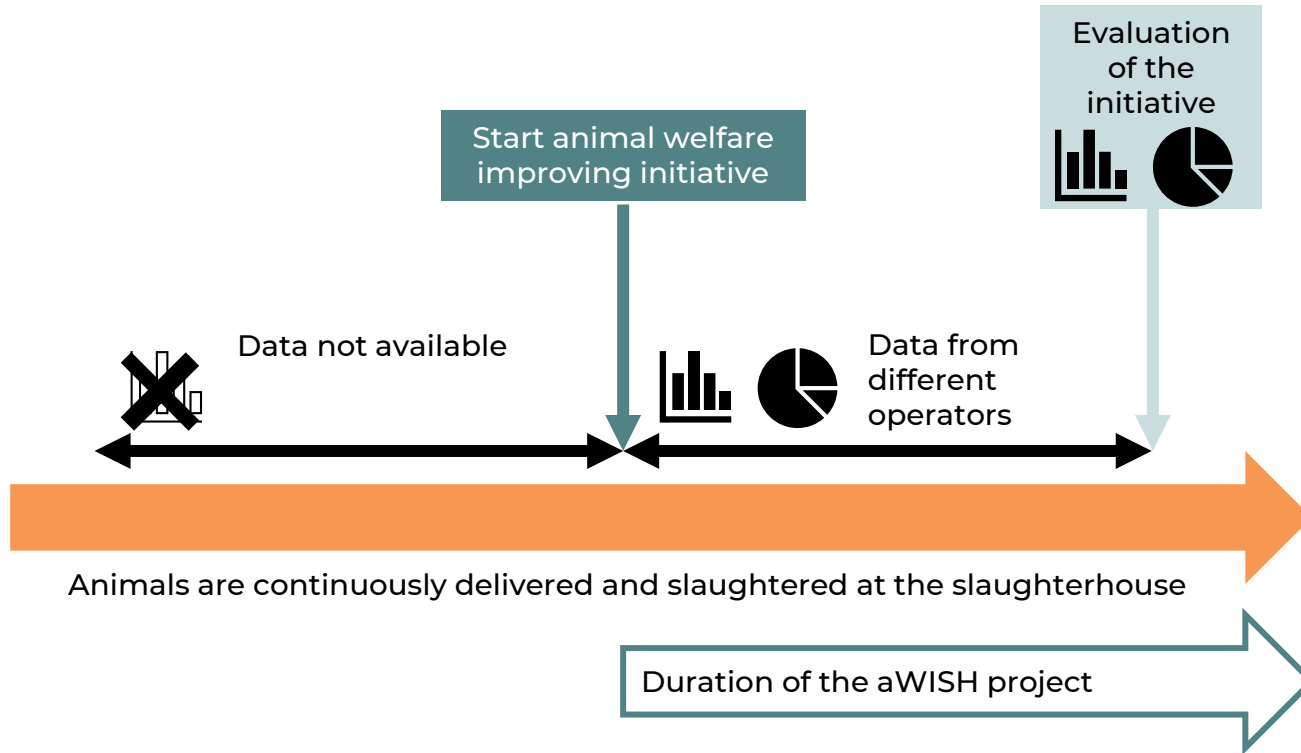
Ideal scenario



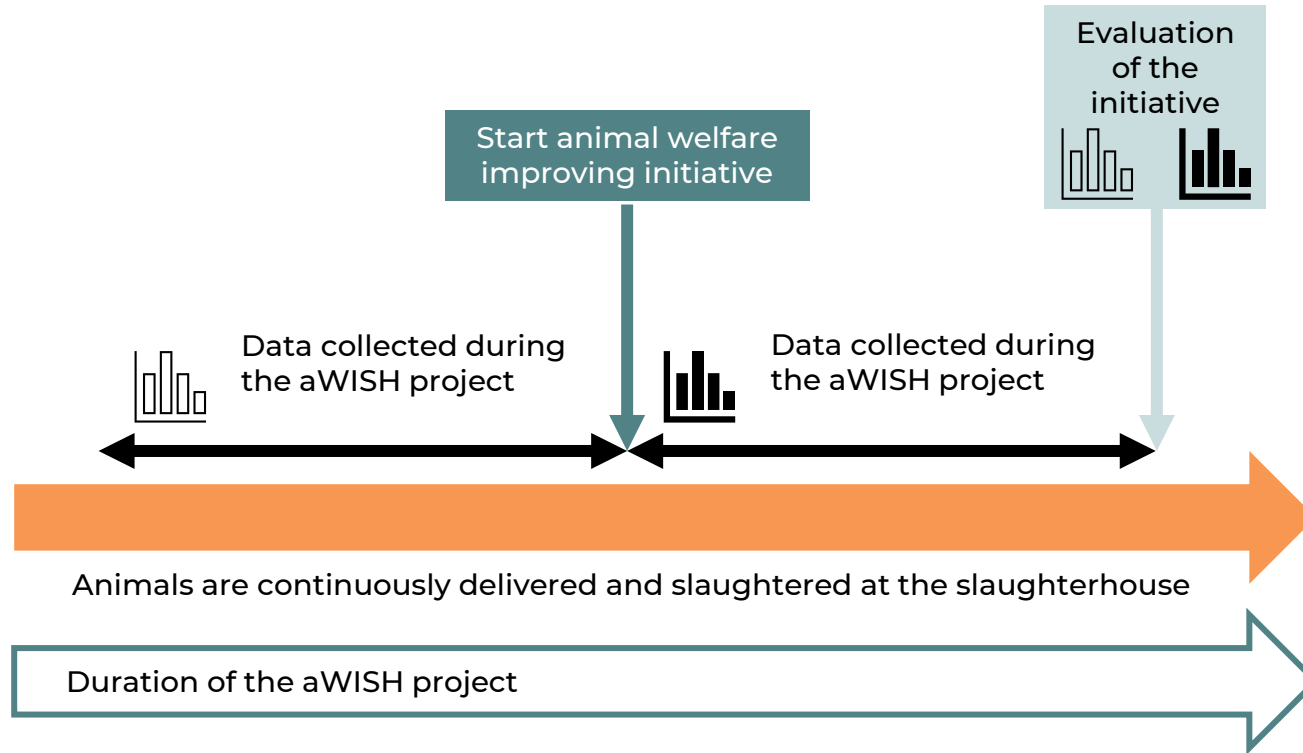
Scenario a)



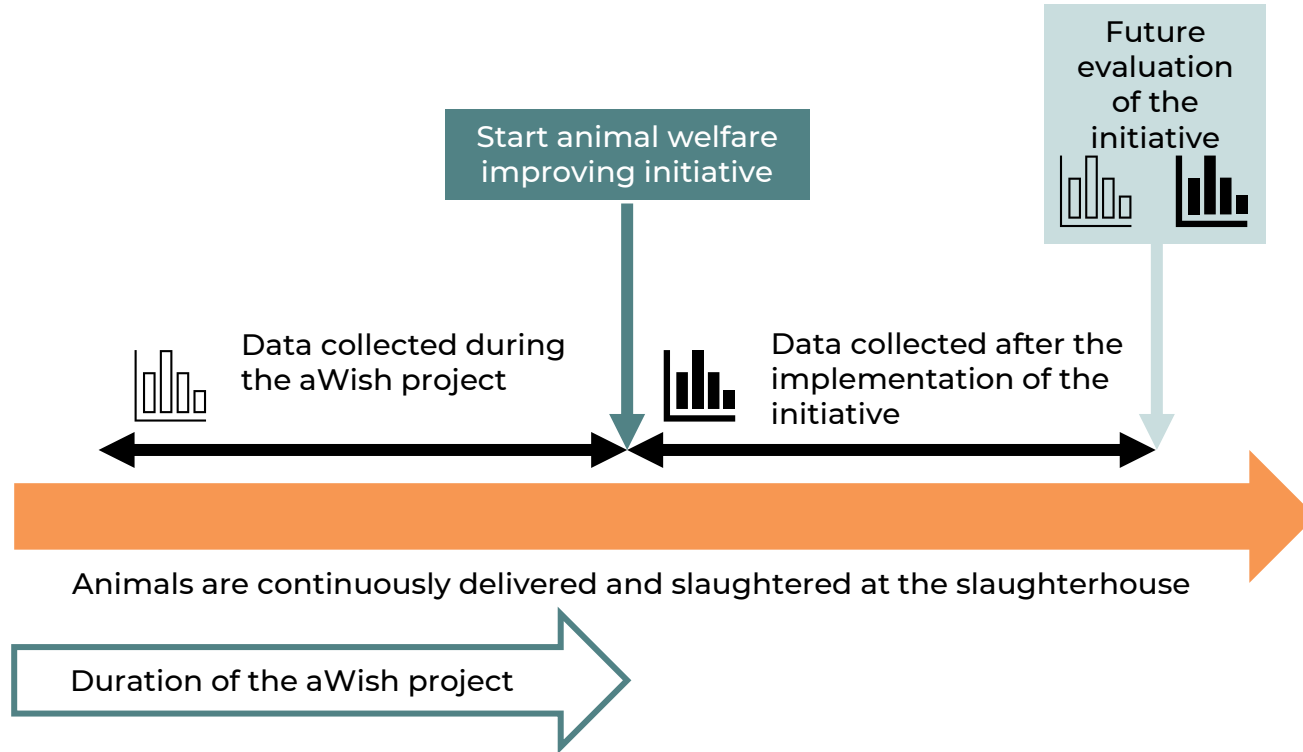
Scenario b)



Scenario c)



Scenario d)



Identification of AWII

- Literature search on AWII
 - Map of animal welfare labelling programmes in the EU
 - No scientific literature on:
 - AWII implemented by individual/small groups of operators on a regional level
 - AWII implemented by regional/national authorities
- Interactive multi-actor session (during the aWISH project meeting in 2024)
 - Identify AWII that are not covered by the scientific literature
 - Explore whether data were available and accessible for an evaluation of AWII (scenario a-c)
 - Not exhaustive, biased towards knowledge of participants



Challenges with the evaluation of AWII

Challenge 1: Volume, variety and lack of detailed information about AWII

- Vast number of regional, national, legal and private AWII
- Smaller, regional AWII which are not linked to a labelling program can only be identified by **'insiders'**
- **Lack of detail ('personal communication', date of implementation)**

Challenge 2: Lack of data availability

- Data are not yet (routinely) collected and recorded
- Lack of data on the baseline situation

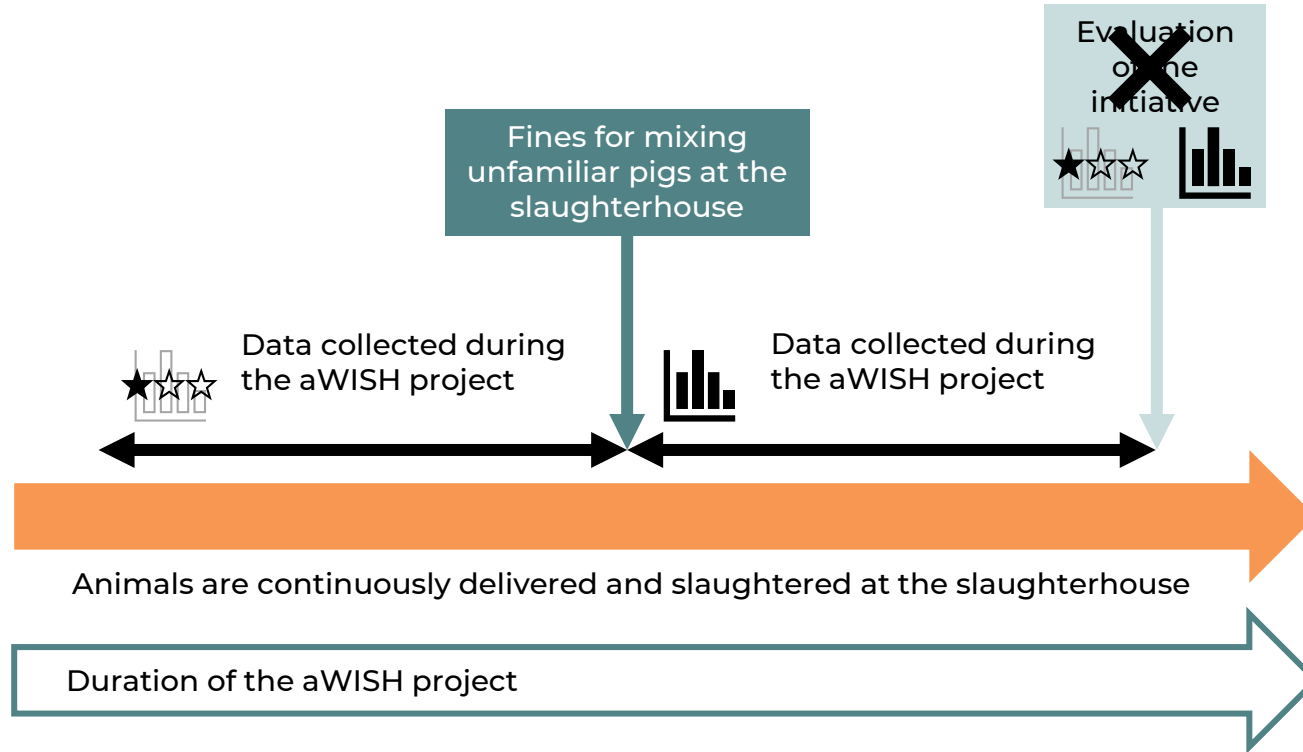
Challenge 3: Lack of data quality & accessibility

- Manual data collection; level of accuracy, reliability, and detail ?
- Automated data collection: covers a limited number of animal welfare indicators
- Serious barriers to get access to data owned by external parties



Solution: focus on AWII for which detailed information and high-quality data are available and accessible

Case: mixing unfamiliar pigs (NL, 2024)



How to proceed?

- Practical challenges that currently impede a comprehensive evaluation of many AWII on regional and national level
- Seems to be a more general phenomenon
- Risk-based inspections, manual audits, little use of routinely collected data
- Unstructured, incomplete, lacking metadata
- Little use of existing ontologies or standard vocabulary



- Continuous, automated collection of high-quality data to draw more accurate and reliable conclusions about actual animal welfare
- Scenario d): evaluation of future AWII
- aWISH data platform
- Crucial that structures established during the aWISH project remain in place and operational
- Further development, refinement, expansion

Conclusions

- Large-scale collection of high-quality data on animal welfare using validated sensor technologies
- If challenges 2 (data availability) and 3 (data quality & accessibility) are tackled, challenge 1 (identification of AWII) is not a challenge anymore



Finally closing the gap between AWII that have **potential** to improve animal welfare and their **actual effects** on the lives of animals in practice



Thank you!



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Mona Franziska Giersberg



Mona F. Giersberg

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**EUROGROUP
FOR ANIMALS**

From animal-based welfare indicators to EU policy integration: lessons from the aWISH project

Dr Helen Lambert
Consultant, Eurogroup for Animals



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The science is advancing. Policy integration is lagging

- Strong scientific knowledge exists on **animal-based welfare indicators**
- Increasing validation of indicators for **pigs and broilers**
- Yet major questions remain around:
 - **applicability at scale**
 - **harmonised measurement and reporting**
 - **integration into legislation and enforcement**
 - **data governance and implementation burden**

Key message:

The challenge is no longer only which indicators are scientifically valid, but how validated indicators can become usable policy tools.



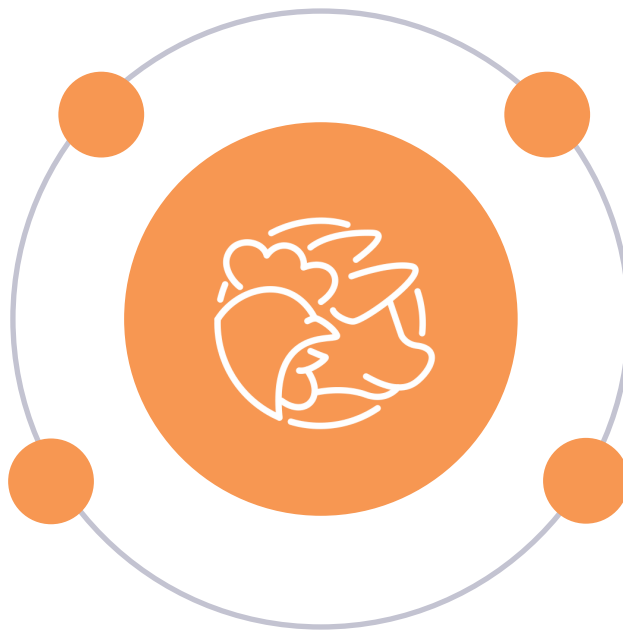
AWIs Are Tools – Not Solutions

AWIs can:

- Reveal whether animals are thriving or suffering
- Support monitoring, compliance, and evaluation

AWIs cannot:

- Fix inherently poor systems
- Replace minimum legal standards



Policy implication:

- Strong legislation must ban or phase out incompatible systems (e.g., cages, fast-growing broilers, mutilations)
- AWIs then enable verification, accountability, and improvement

Key message: Indicators are effective only when embedded in ambitious law

Why this matters now: EU welfare reform

**EU animal welfare
legislation is dated
and does not fully
reflect current
scientific evidence**

**Animal-based
measures already
feature in EU law,
but their use is
inconsistent**

**Current reform creates
an opportunity to
embed outcome-
based measures more
systematically**

**AWIs can help assess
whether revised
standards deliver
better welfare
outcomes**



AWIs are already in EU policy, but inconsistently

AWIs are not new to EU legislation

Existing examples include mortality and footpad dermatitis in broilers

Animal-based measures can already inform inspection and compliance.
But implementation differs between Member States.

Current limitations

Different definitions and measurement approaches

Fragmented reporting and datasets

Limited EU-wide comparability and benchmarking

Key message:

The challenge is not starting from zero, but moving from fragmented use towards a coherent system.

From scientific validity to policy readiness

Policy-ready AWIs need to be:

Practical

Feasible and scalable in real-world settings
Clear measurement methods and proportionate costs

Harmonised

Common definitions, calibration and reporting
Comparable across Member States and systems

Embedded

Integrated into legislation, inspections and assurance
Uses existing data and governance structures where possible



Key message:

Scientific validity is necessary, but policy readiness also depends on feasibility, consistency and integration.

Lessons from the aWISH policy workshops



Build on what already exists

Use existing inspection, public and private data systems

Measurement needs consequences

Thresholds, targets and benchmarking determine how data are used

Implementation burden matters

Farmers, authorities and industry need proportionate, workable systems

Policy uptake needs several levers

Legislation alone cannot deliver implementation, incentives and communication

Key message:

Policy uptake depends on the system around the indicator, not only the indicator itself.

Embedding AWIs in EU Policy Channels

Legislation & official controls

- Integrate AWIs into species-specific legislation
- Support risk-based inspections and outcome-based monitoring

Funding & incentives

- Link support to measurable welfare outcomes
- Reward improvement beyond the legal minimum

Labelling & trade

- Underpin credible welfare claims
- Support verification and comparability

Digitalisation & data

- Enable harmonised reporting and benchmarking
- Reduce burden and support feedback loops



Key message:

AWIs can support several policy functions, but only if the data are comparable and connected to clear policy objectives.



From indicators to action: the Italian example

What is ClassyFarm?

- A national digital platform used by the Italian Ministry of Health and regional authorities
- Brings together data from farm assessments, veterinary inspections and laboratory results
- Uses these data to categorise risk and prioritise official controls

How welfare indicators are used

- AWIs contribute to monitoring and inspection
- Welfare outcomes can inform financial support under agricultural funding schemes
- Data support feedback between farmers, veterinarians and authorities

Why it matters

- Shows that AWIs can be linked to enforcement, incentives and improvement within one system

Key message:

ClassyFarm provides a practical example of how outcome-based welfare data can be embedded within existing administrative structures.

Who makes implementation happen?



EU level

- Common definitions and measurement frameworks
- Comparability and data standards
- Legislative framework and guidance

Member State level

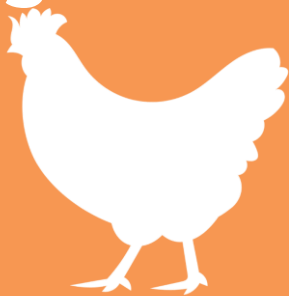
- Data collection and verification
- Inspection and enforcement
- Training, capacity and adaptation to national systems

Shared

- Data governance
- Calibration and learning
- Feedback and continuous improvement

Key message: Harmonisation requires common rules, not necessarily identical delivery.

A staged pathway to policy integration



Short term

- Prioritise a core set of indicators
- Pilot feasibility and measurement protocols
- Make use of existing data systems

Medium term

- Harmonise definitions, calibration and reporting
- Develop thresholds, targets and benchmarking
- Strengthen guidance and implementation support

Long term

- Embed AWIs within legislation and official controls
- Link to incentives and wider policy mechanisms
- Use outcomes to evaluate and improve policy

Key message: Start with what is workable, learn from implementation, harmonise and scale.

Key policy recommendations



- **1. Outcomes complement standards**
- Strong legal baselines remain essential; AWIs show whether they deliver for animals.
- **2. Validation is only the beginning**
- Policy use also requires feasibility, harmonisation, governance and clear consequences.
- **3. Measure to act**
- AWI data should inform enforcement, incentives, evaluation and continuous improvement.

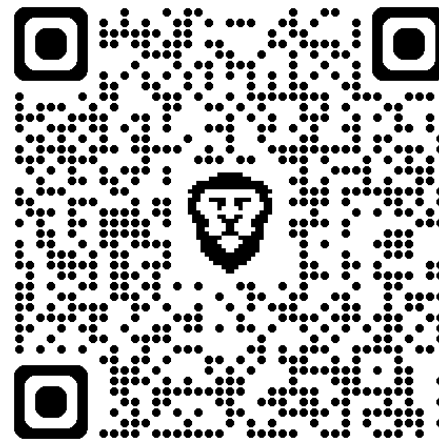
Bottom line:
**The goal is not simply better welfare measurement,
but better welfare through better policy.**

From Indicators to Implementation:

Pathways for EU Welfare Reform

Policy Workshop - Report

14 JANUARY 2026 | 12:30-17:00 CET





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Thank you.

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77th EAAP Annual Meeting
Hamburg, Germany

A systematic review of sensor technologies for automated welfare assessment of broilers

Forkman, B., Llonch, P., Ramon-Perez



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UNIVERSITY OF
COPENHAGEN

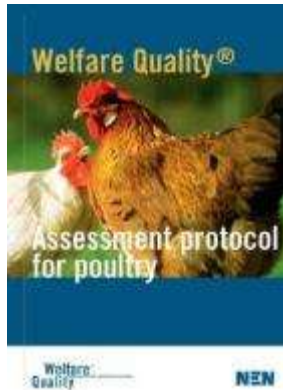
UAB

Universitat Autònoma
de Barcelona

INTRODUCTION



- Animal welfare protocols often necessitates farm visits
- Welfare is multidimensional => many measures are needed
- These take time and are costly
- Automatic monitoring and use of sensors



MATERIALS AND METHODS



Scientific literature



AW indicators

Web of Science, Scopus y PubMed

n = 65 papers

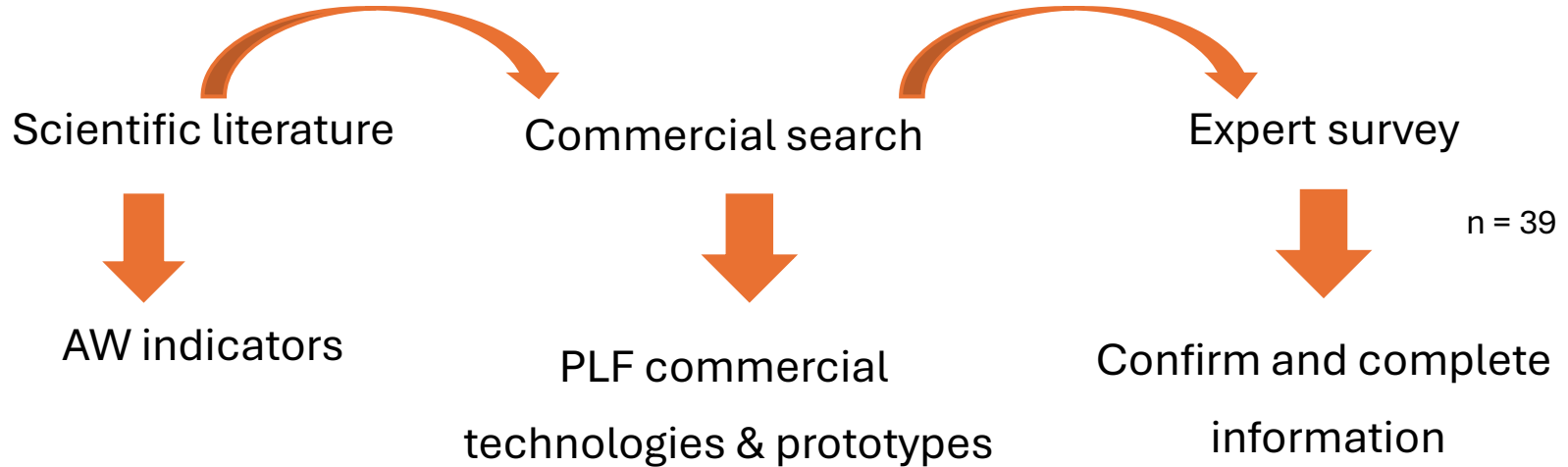
n = 51 indicators



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MATERIALS AND METHODS



Web of Science, Scopus y PubMed

n = 65 papers

n = 51 indicators

Google & experts

n= 67 technologies

n= 24 indicators



The technology solutions



53 technologies on farm

5 technologies during transport

7 technologies at slaughter



Multidimensional?

Mental
2

Health
33

Environment
12

Feed
20

Behaviour
2

Validation

• Sensor name	Indicator
• HF RFID reader DSLR1000 D	Activity
• BroilerZoom Animoni	Body weight
• SOMO SoundTalks	Body weight
• HD-B-1001 Youanhong Tech	Vocalisations
• FlirOne; Lepton FLIR	Body temperature
• Meyn Foot Pad Inspection	Footpad dermatitis
• eyeNamic Fancom BV	Gait score
• Zoom H4n Zoom	Distress vocalisations
• Somo sound talks Somo	Sneezing
• Microvision EM130C	Body posture



Criticism and wishlist

- Validation provided - 72% of the experts
- External transparent validation – 85% of the experts
- Ecological validity - breed etc emphasised
- "Robustness"

Conclusion

- There is an urgent need not only to develop new technologies but validate existing ones



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Validation of an automated system for at-slaughter assessment of footpad dermatitis and hock burn in broiler chickens

*N. van Staaveren, K. van Langeveld, J. Schulte-Landwehr, J. Mulder,
P. Galliot, P. Créach, P. Sztandarski, J. Marchewka, B. Forkman,
N. Van Noten, F. A. M. Tuytens, M. F. Giersberg, M. Manet,
T. B. Rodenburg*



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Introduction

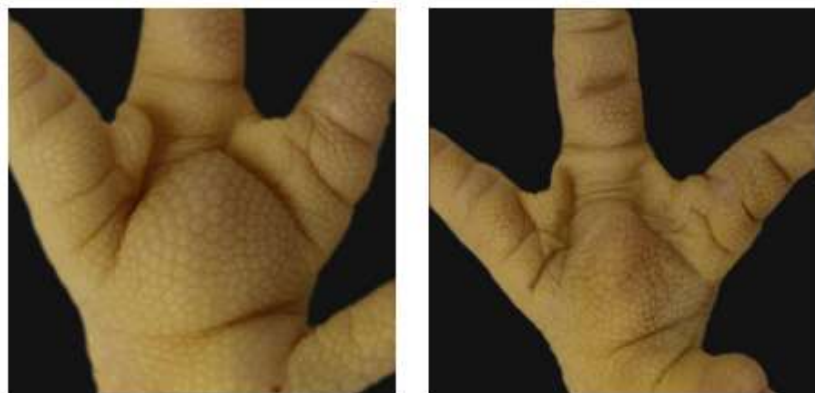
- Footpad dermatitis (FPD) and hock burn are common welfare problems in broilers approaching slaughter weight
 - Poor litter quality (moisture, ammonia)
 - Low activity levels, high stocking density
- On-farm assessment is challenging: requires catching and handling of birds
- EU broiler directive (2007): mortality and FPD scores as animal-based measures
- Automated monitoring at slaughter has major advantages (accurate system required)

Scores: four categories (% foot pad affected)

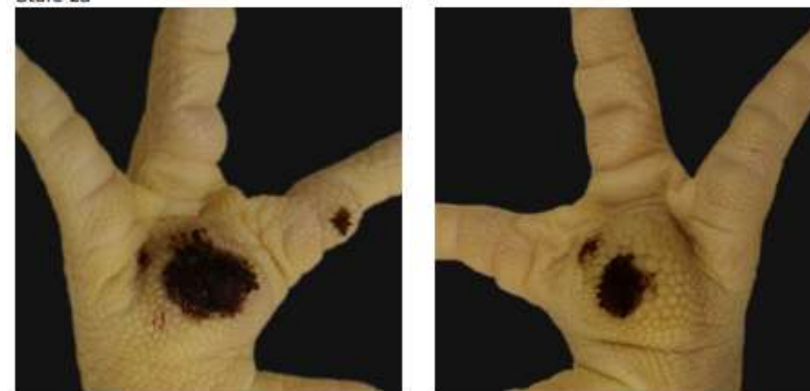


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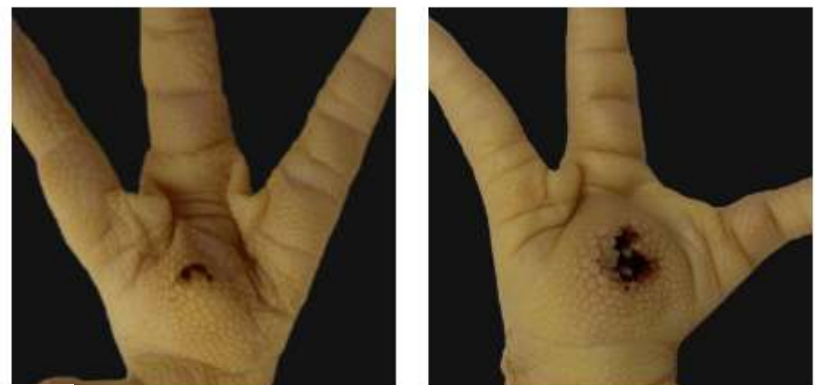
Stufe 0



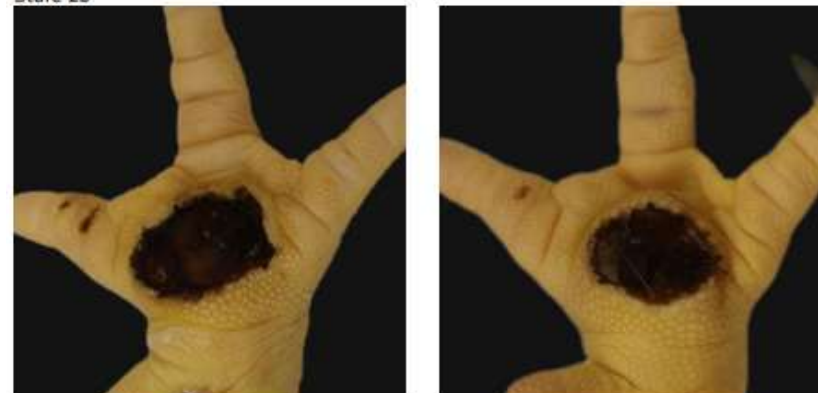
Stufe 2a



Stufe 1



Stufe 2b



Measures the average percentage of lesions on the sole.

Camera system at the return line of the legs. The associated algorithm detects the lesions through color differences, where the lesion area determines the severity.



Overview System



CHICKENCHECK FOOTPAD

Measures the area (mm²) of hock burns

Camera system immediately after the plucking of the animals. The associated algorithm detects the burn marks through color differences, where the burn mark area determines the severity.



Overview System



CHICKENCHECK HOCKBURN



Aim of the study

External validation of the ChickenCheck system in two different slaughterhouses (France and Poland)

Comparing the scores assigned by the system with scores assigned by three human experts (silver standard)

Human experts had experience with assessment of FPD and hock burn in broilers

Humans assessed the same pictures as the system

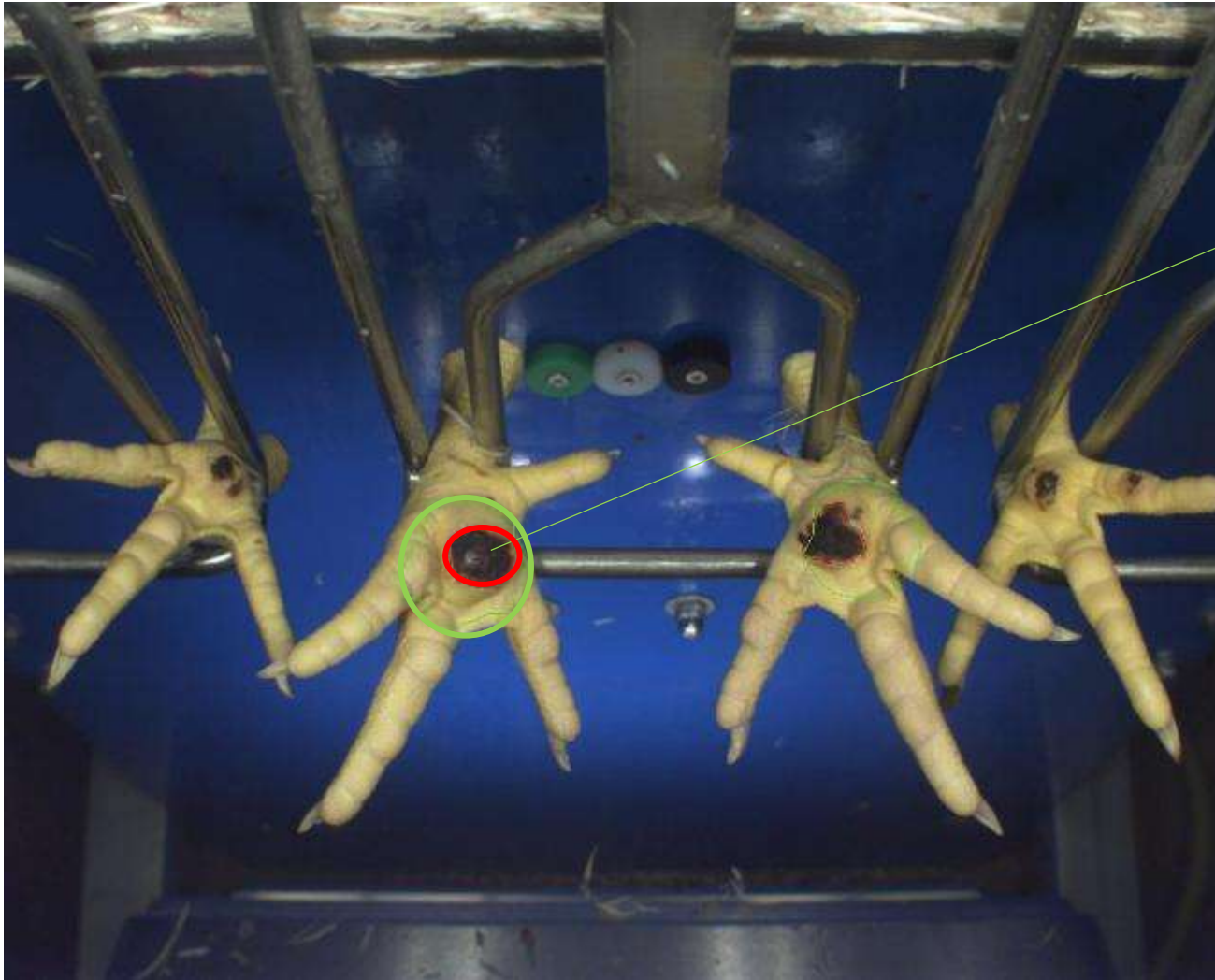
aWISH Validation study FPD + hock burn



Training data set
of 50 images (100
feet and hocks):
agreement on
scores

Validation data
set of 500
images (1,000
feet and hocks):
comparison
humans and
system

Challenge: estimating % area affected



20, 30 or 40%???

Scorer1: Score 2b
Scorer2: Score 2a
Scorer3: Score 1

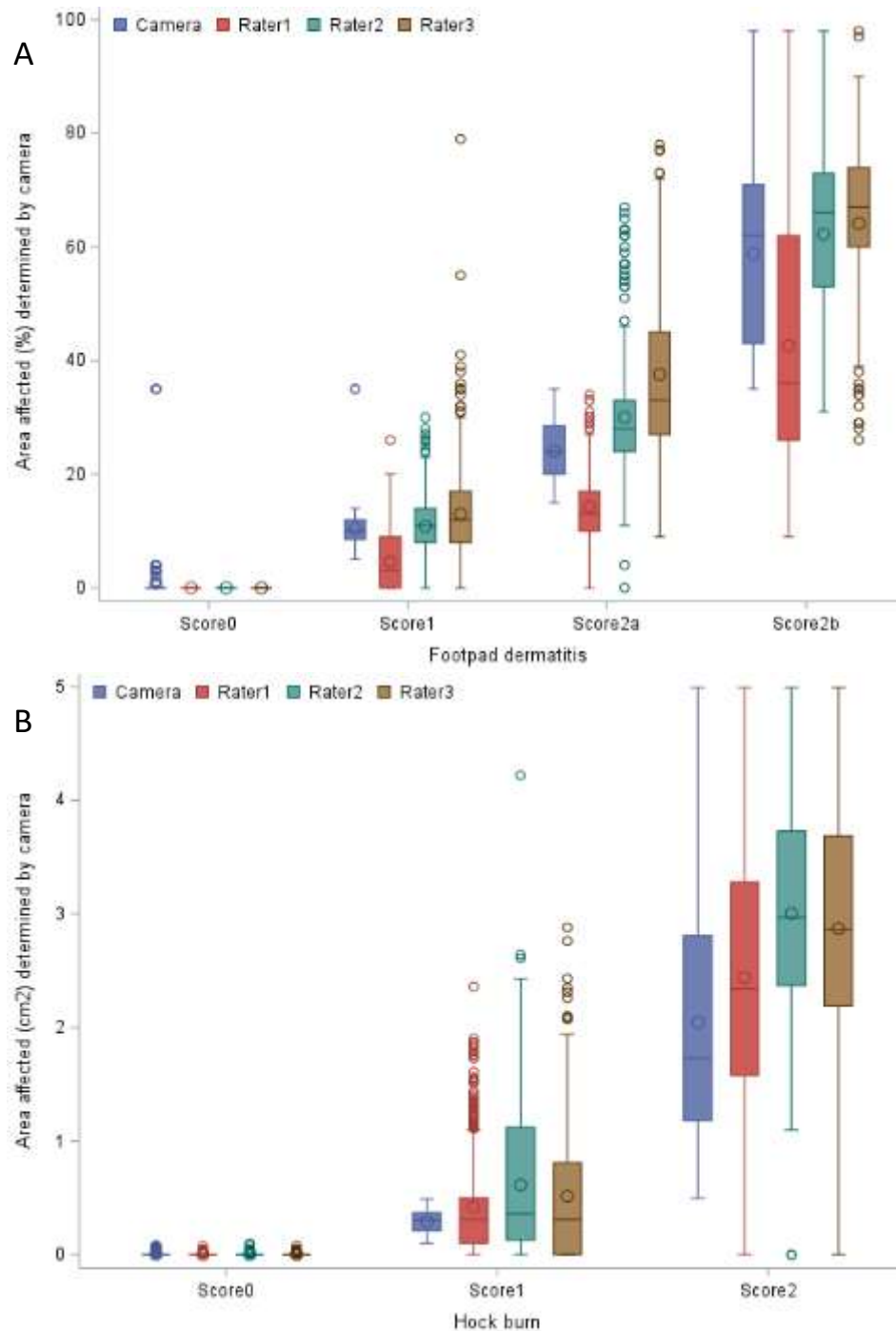
CLK: 26% -> Score 2a

Validation of welfare indicators

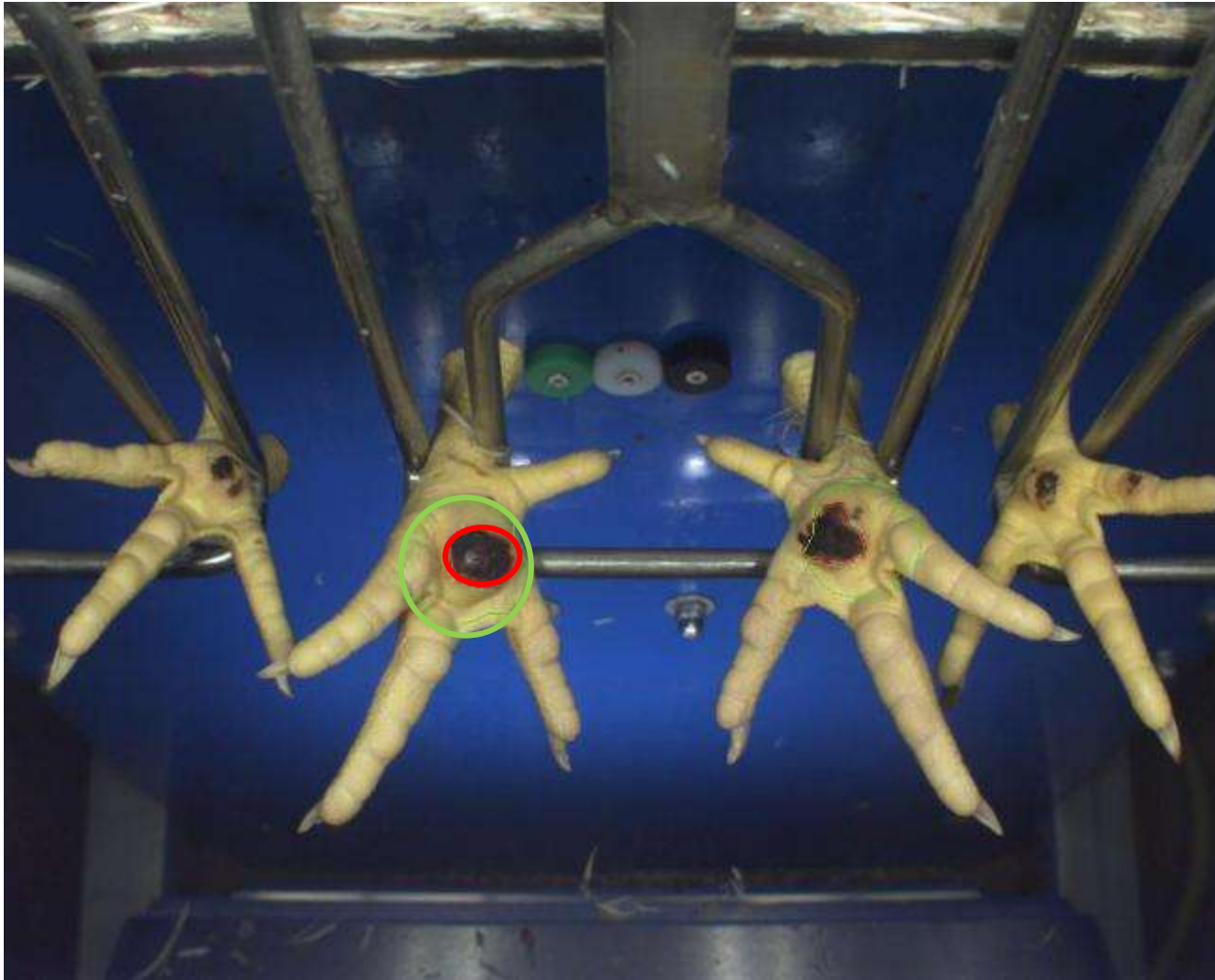
Humans: fair to moderate agreement (kappa 0.33-0.47)

With system: moderate to substantial agreement (kappa 0.60-0.70)

Hard for human to assess size or % affected area



aWISH Validation study FPD + hock burn



Adjusted
method of
validation:

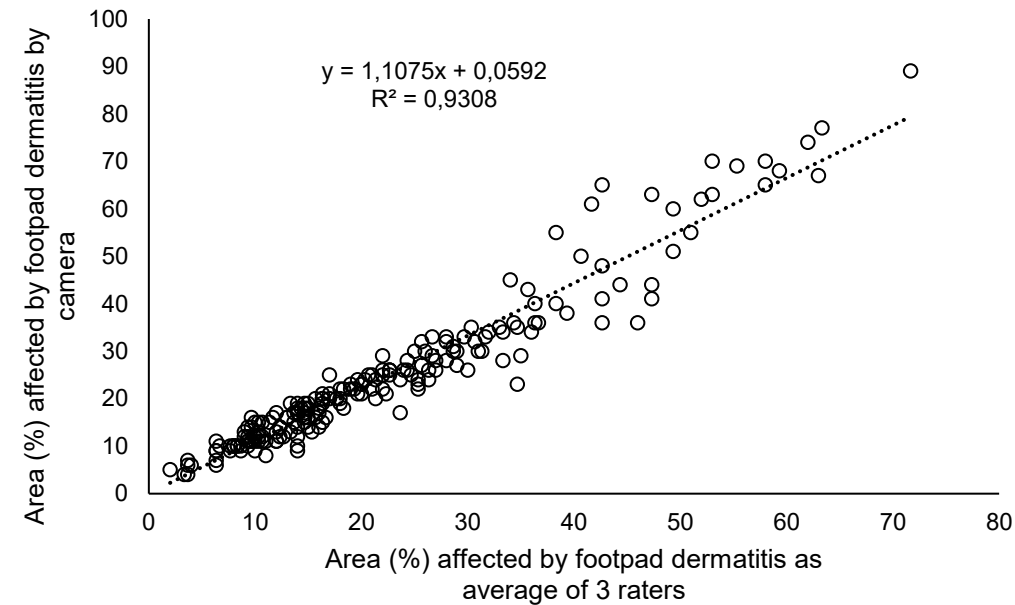
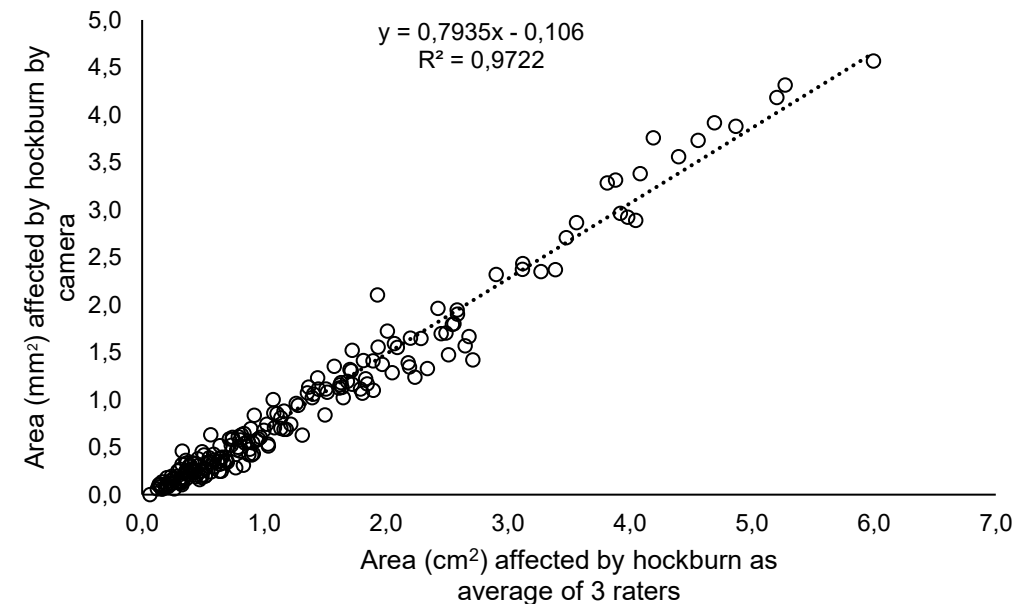
Compare size of
selected area

Drawn by human
assessor vs.
system

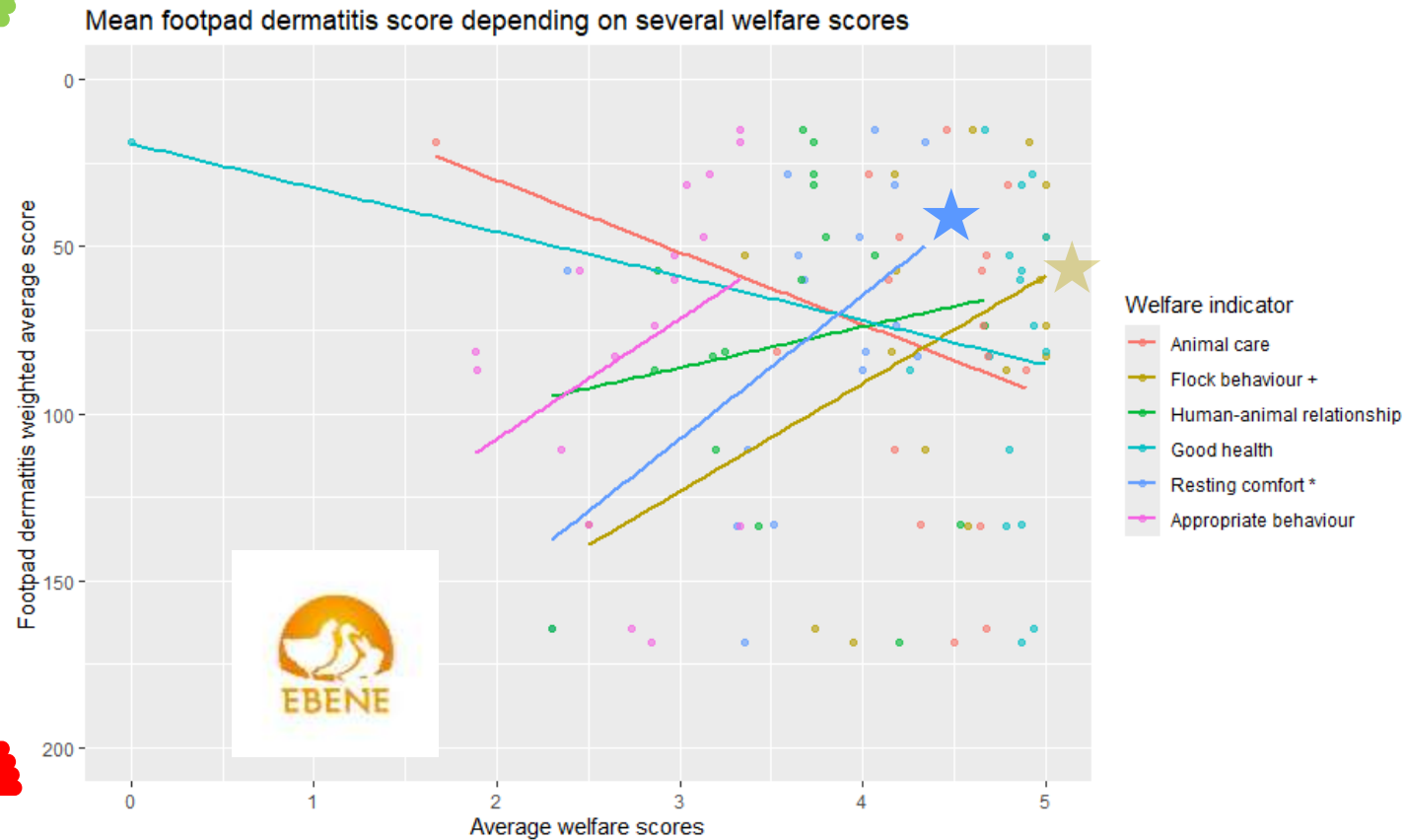
Comparison size selected area

Human assessors and camera system indicated a similar size of lesions on the footpad ($R^2: 0.93$) and hock burn ($R^2: 0.97$)

Size of lesions is correctly annotated by the system



Correlations on-farm welfare scores (27 flocks, France) and FPD ChickenCheck scores



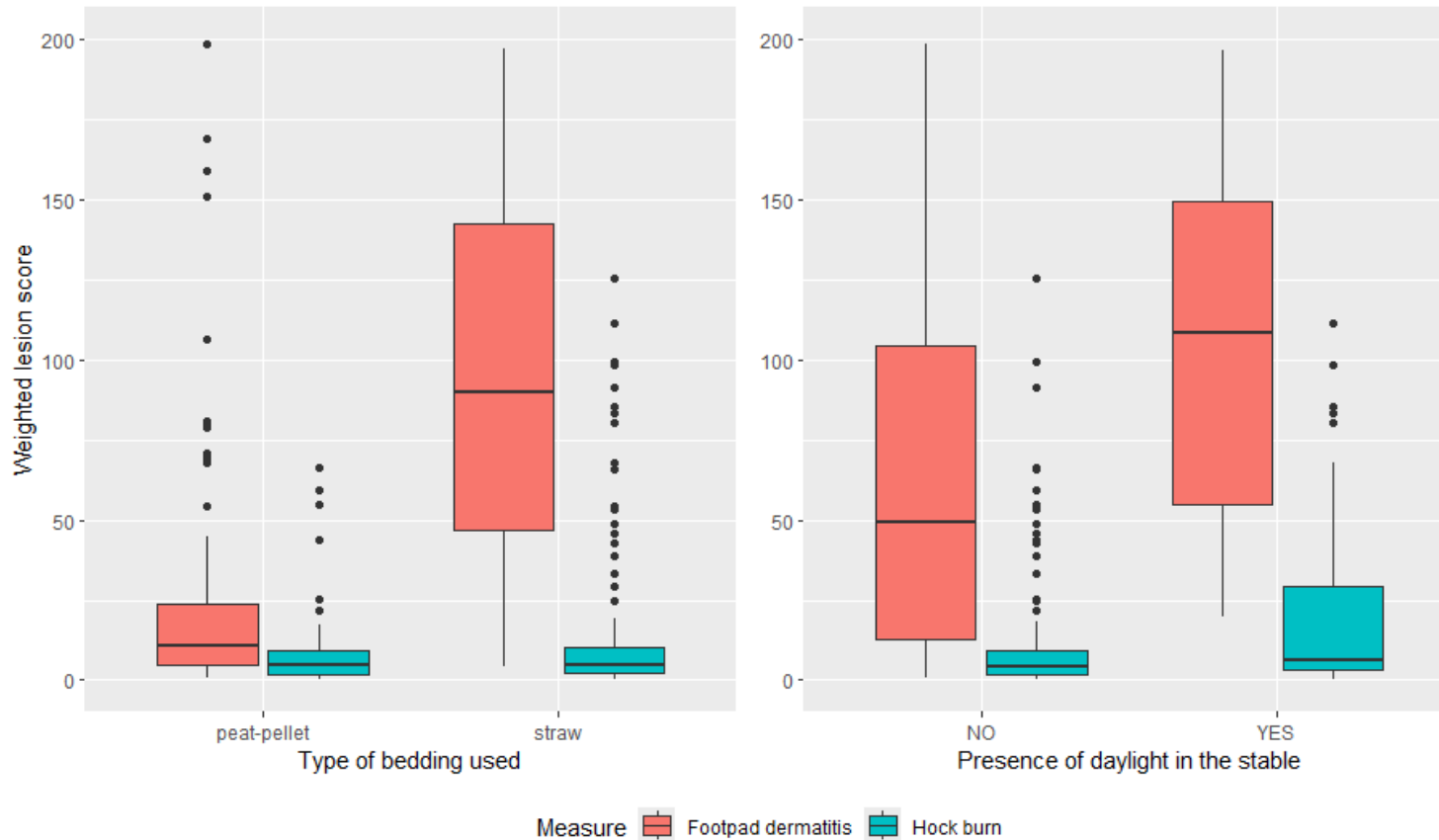
Better footpad scores:

- Better litter quality
- More positive social behaviour (tendency)

Manet et al (in prep)



Correlations farm management and ChickenCheck (285 flocks, Poland)



Better footpad scores:

- Peat pellets over straw

Better hock burn scores:

- No daylight over daylight

Conclusion

- Automatic assessment of FPD and hock burn is a valuable tool to collect (some) welfare data at slaughter
- The ChickenCheck system could be validated with human assessors
- Humans and system selected similar size areas affected by FPD and hock burn
- Offers perspective for practical broiler welfare assessment, especially when combined with other welfare data



Funded by the
European Union

Thank you!



Thanks to participating
farmers and slaughterhouses!



Dr. Nienke van Staaveren and
Dr. Maëva Manet for driving the
study

Link to full paper:

<https://doi.org/10.1016/j.psj.2026.106968>



Poultry Science
Volume 101, Issue 7, July 2026, 106968



Full-length Article

Validation of an automated system for at-
slaughter assessment of footpad dermatitis
and hock burn in broiler chickens

Biochemical and molecular reference approach for validation of vision systems that automatically record catching damage in broiler chickens at slaughter

PhD Patryk Sztandarski¹, Aneta Jaszczyk¹, Joanna Marchewka¹, Magdalena Solka¹, Jagoba Rey-Gotxi¹, Adrianna Szprynca¹, Jan Schulte-Landwehr², Jorinde Mulder³, Magdalena Kuras-Smolnik³, Frank Tuytens^{4,5}, Bas Rodenburg⁶

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⁴*Animal Sciences Unit, Flanders Research Institute for Agriculture, Fisheries and Food (ILVO), Merelbeke-Melle, Belgium*

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European Federation of Animal Science Conference

Hamburg, Germany 10 September 2026



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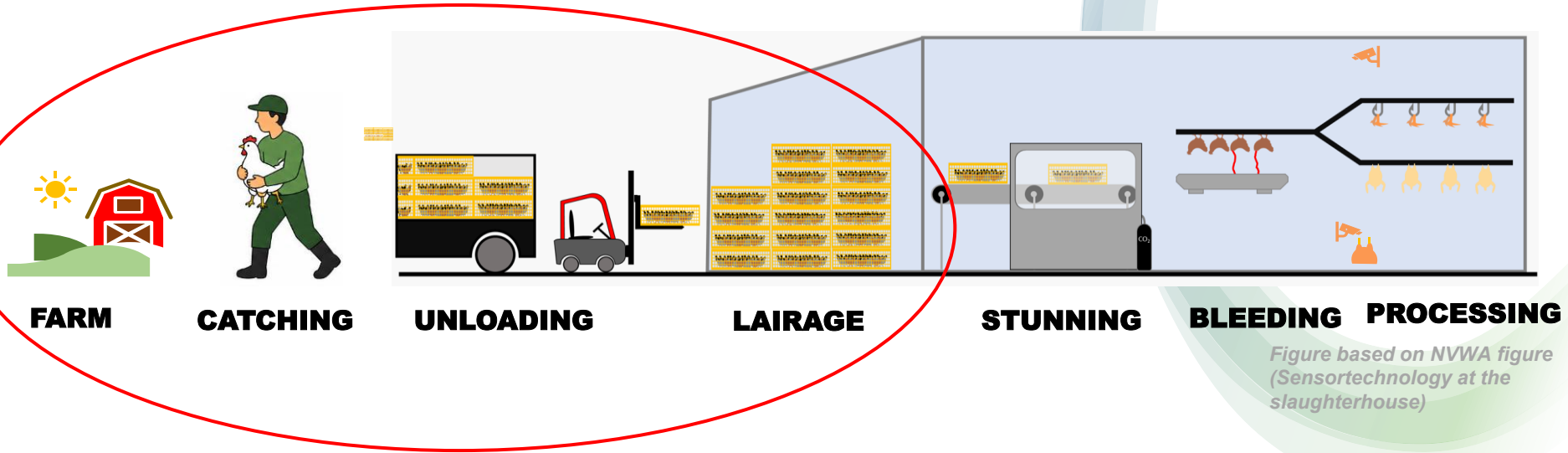


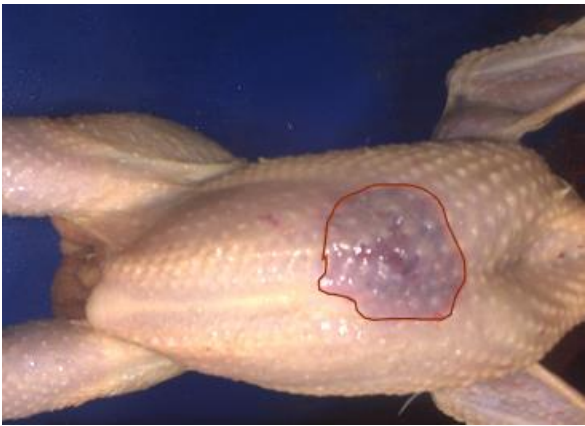
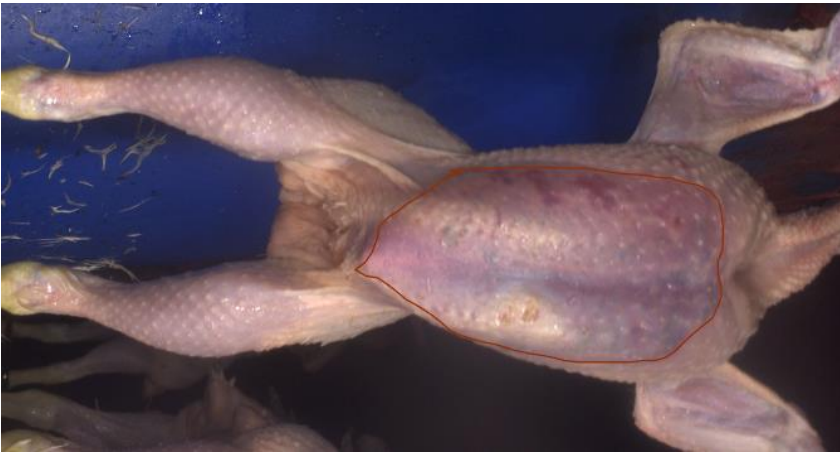
INSTITUTE OF GENETICS
AND ANIMAL BIOTECHNOLOGY
of the Polish Academy of Sciences



Funded by
the European Union

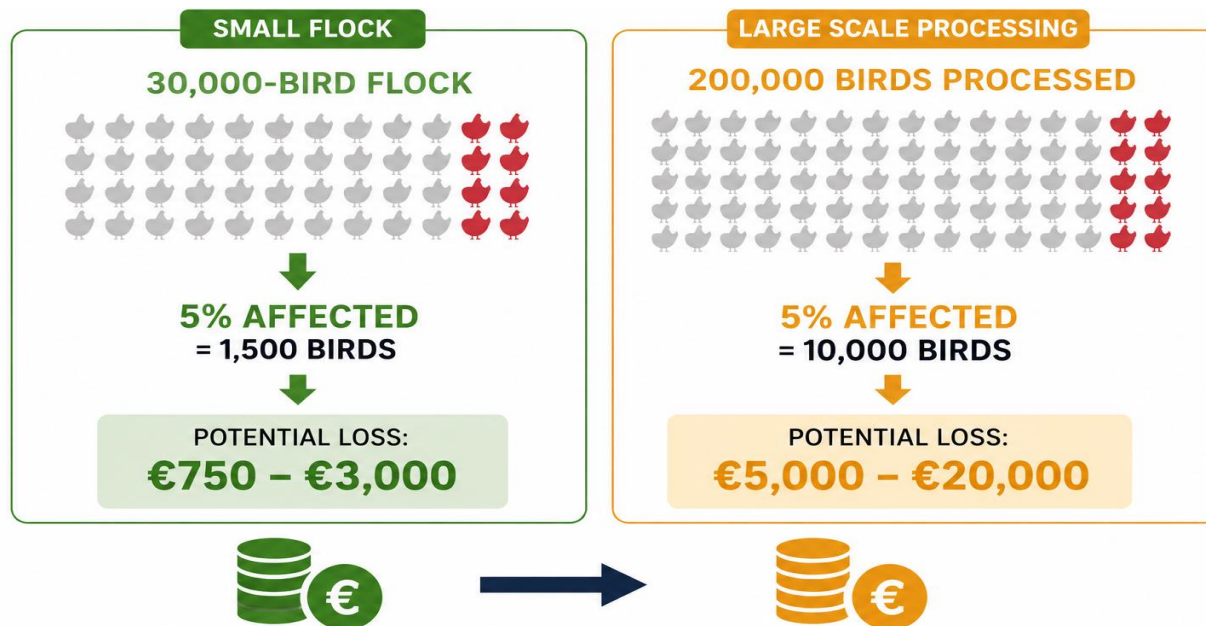
CATCH DAMAGE PROBLEM





IMPLICATIONS

- Welfare impairment
- Bruising & fractures
- Increased mortality
- Carcass downgrading
- Economic losses
- Farmer–processor disputes over injury responsibility
- Challenges in assigning responsibility within the production chain



AIM & HYPOTHESIS



The aim of this research is to **investigate** whether **biochemical and molecular markers** can be used to **estimate bruise age** and provide an **objective method** for evaluating catch damage in broiler chickens.

Hypothesis: Bruise progression is associated with predictable changes in colour and biochemical / molecular composition that can be used to estimate bruise age.



METHODOLOGY

1 Bruise measurement in situ



Bruise color was measured non-destructively using a portable spectrophotometer. Spectral data (e.g., L^* , a^* , b^* , ΔE^* , reflectance) were recorded for each bruise.

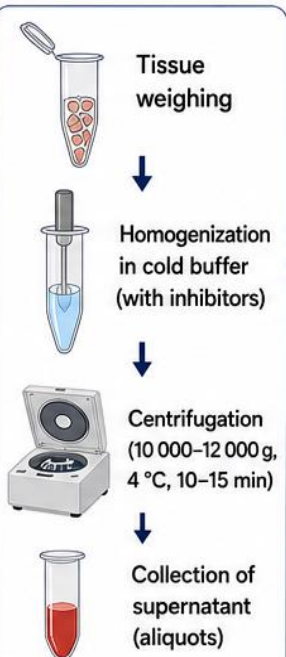
2 Sample collection



From each measured bruise, a tissue sample was collected.

Samples were labeled, placed on ice, and stored at -80°C until analysis.

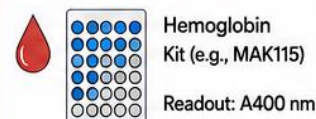
3 Sample preparation



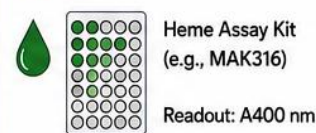
Samples were homogenized in cold buffer with protease inhibitors, centrifuged, and clear supernatants were collected.

4 Biochemical analysis using kits

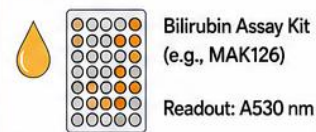
Hemoglobin (Hb)



Heme



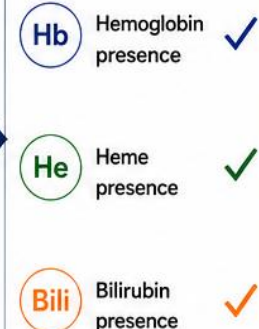
Bilirubin



Specific colorimetric assay kits were used to quantify hemoglobin, heme, and bilirubin in each bruise sample.

5 Element presence assessment

For each bruise, we evaluated:



Concentration (μM or mg/dL) was calculated based on standard curves for each kit.

6 Data integration and interpretation



Spectrophotometric data were integrated with biochemical results to characterize bruise composition.

Outcome

Characterization of bruise composition and better understanding of bruise development.

Results were analyzed to assess relationships between bruise color (spectral data) and the presence/concentration of hemoglobin, heme, and bilirubin.



Birds were assessed from one transportation truck containing approximately **6,000** broilers.



A total of **79** carcasses with visible bruises were identified.



Only bruises with a diameter **$\geq 1\text{ cm}$** were included in the analysis.

RESULTS

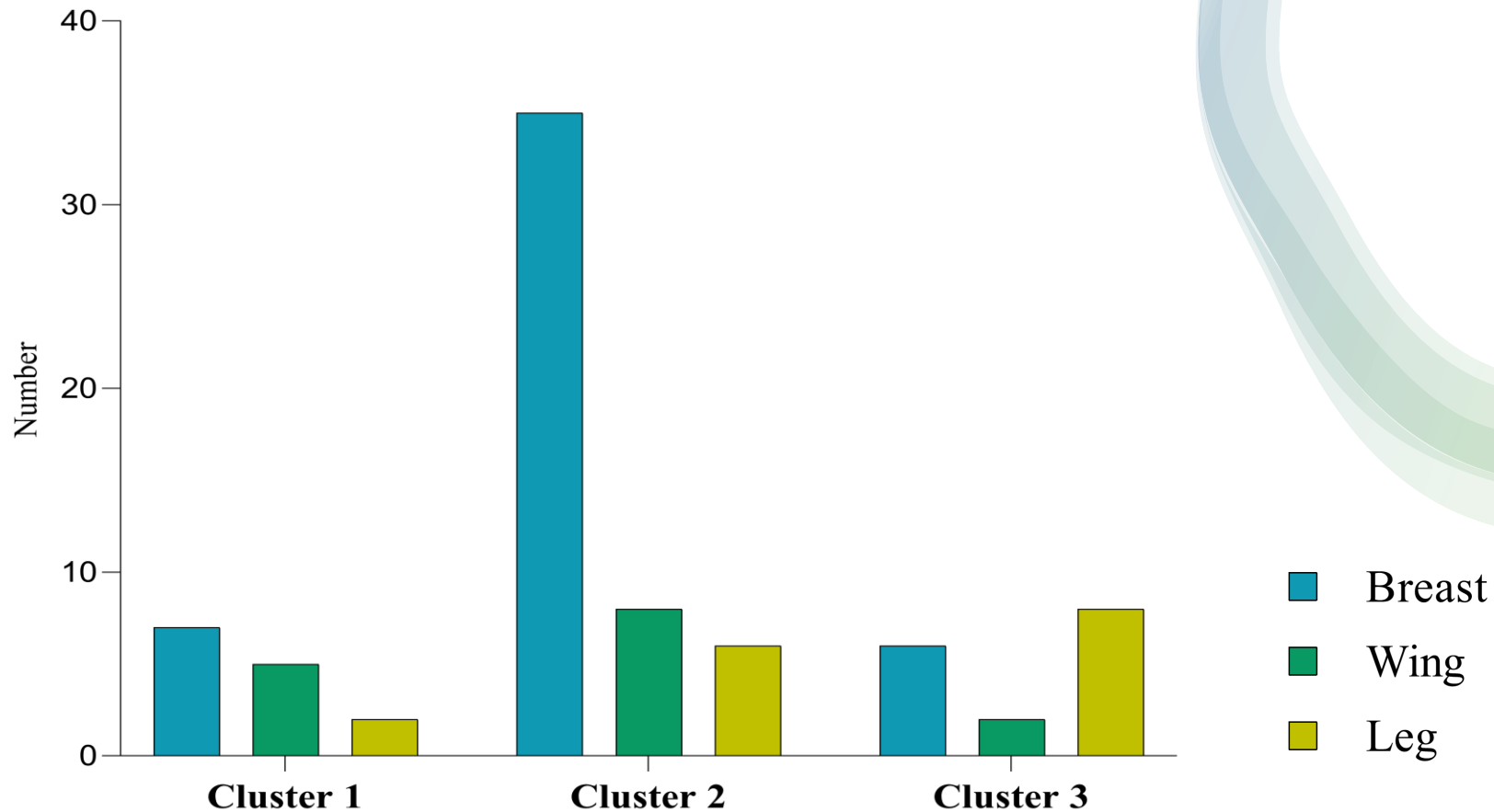


Figure 1. Distribution of bruise colour clusters. Bars represent the number of breast, wing, and leg bruises assigned to each cluster identified by hierarchical clustering of CIE L^* , a^* , b^* , and ΔE^* parameters.

RESULTS

Table 1. Spectrophotometric characteristics of bruises at different stages of progression (mean $\pm$ SD).

Bruise stage	L* (lightness)	a* (redness)	b* (yellowness)	ΔE^*
Fresh	32.5 $\pm$ 3.8 ^c	21.8 $\pm$ 2.9 ^a	-2.1 $\pm$ 2.4 ^c	63.4 $\pm$ 5.6 ^a
Intermediate	38.7 $\pm$ 4.1 ^b	14.2 $\pm$ 2.5 ^b	4.6 $\pm$ 2.8 ^b	56.8 $\pm$ 5.1 ^b
Older	46.9 $\pm$ 4.5 ^a	12.2 $\pm$ 3.6 ^b	13.8 $\pm$ 3.1 ^a	49.2 $\pm$ 4.7 ^c
<i>P-value</i>	<0.001	<0.001	<0.001	<0.001

Different superscript letters (a–c) within a column indicate significant differences ($P < 0.05$; one-way ANOVA followed by Tukey's post hoc test).



RESULTS

Table 2. Changes in biochemical markers during bruise progression.

Bruise stage	Hemoglobin (mg/g)	Heme ($\mu\text{mol/g}$)	Bilirubin ($\mu\text{mol/g}$)
Fresh	8.4 ± 1.6^a	2.8 ± 0.7^b	0.4 ± 0.2^c
Intermediate	5.1 ± 1.2^b	4.6 ± 0.9^a	1.7 ± 0.5^b
Older	2.3 ± 0.8^c	3.2 ± 0.8^b	4.9 ± 1.1^a
<i>P-value</i>	<0.001	0.003	<0.001

Different superscript letters (a–c) within a column indicate significant differences ($P < 0.05$; one-way ANOVA followed by Tukey's post hoc test).

- Hemoglobin decreased with bruise progression, whereas bilirubin increased as hemoglobin degradation progressed.
- b^* (yellowness) was strongly associated with bilirubin concentration, $r = 0.72$, $p < 0.001$

CONCLUSIONS

- Spectrophotometric measurements showed consistent changes in bruise colour over time.
- Hemoglobin, heme, and bilirubin showed distinct patterns at different bruise stages.
- Combining spectrophotometric measurements with biochemical markers may improve bruise age estimation.
- These results support the development of objective methods for assessing catch damage in broilers.

LIMITATIONS & PRACTICAL IMPLICATIONS

- Validate the approach using **larger datasets** and **narrower bruise-age intervals**
- Molecular analyses are ongoing, focusing on: **early inflammation** (*IL1 β* , *IL6*, *TNF- α*), **immune-cell recruitment** (*CXCL8*, *CCL2*), and **tissue remodelling** (*MMP9*, *TGFB1*).
- Integrate **spectrophotometric**, **biochemical** and **molecular markers** into AI models for bruise-age estimation.
- Use laboratory biomarkers as a **reference for validating** automated vision systems.
- **Transfer** the approach **to RGB camera systems** for rapid, non-invasive bruise age assessment.
- Integrate the technology into **automated** slaughterhouse **vision systems** to improve catch damage detection, traceability and welfare monitoring.

THANK YOU FOR YOUR ATTENTION

PhD Patryk Sztandarski

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This research was supported by the project Animal Welfare Indicators at the Slaughter House (aWISH), Grant Agreement ID: 101060818, HORIZON programme.

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Toward operational heat stress monitoring in poultry transport: a CFD-trained surrogate model

10/09/2026

Yann Guyot, Pauline Créach

Heat stress during transport



- **Economic losses:** increased DOA (dead-on-arrival birds), weight loss, and reduced meat quality.
- **Animal welfare:** compromised health and comfort of the birds.
- **Climate change:** increasing heat intensifies the risks of heat stress.

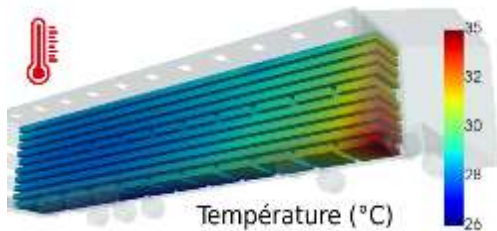
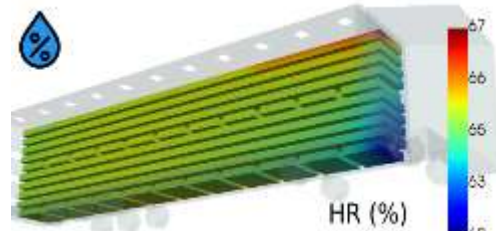
Decision tool to assess transport feasibility and define safe density, departure time, and maximum duration.



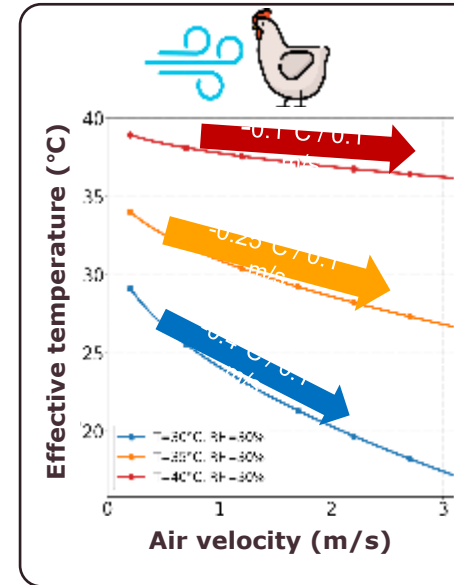
3D CFD model - Previous study

Computational Fluid Dynamics (CFD) study have successfully characterized thermal heterogeneity

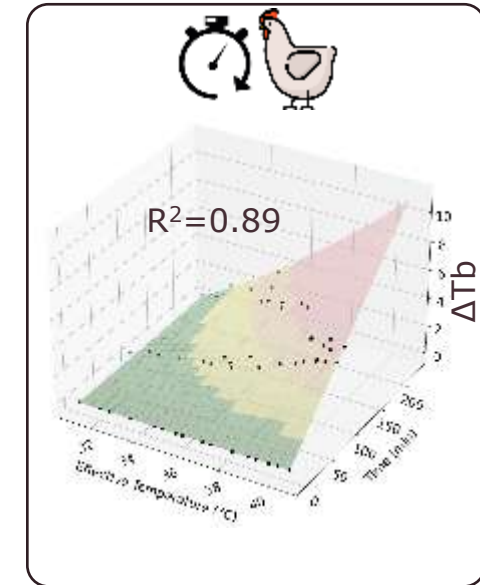
Vitesse d'air (m/s)

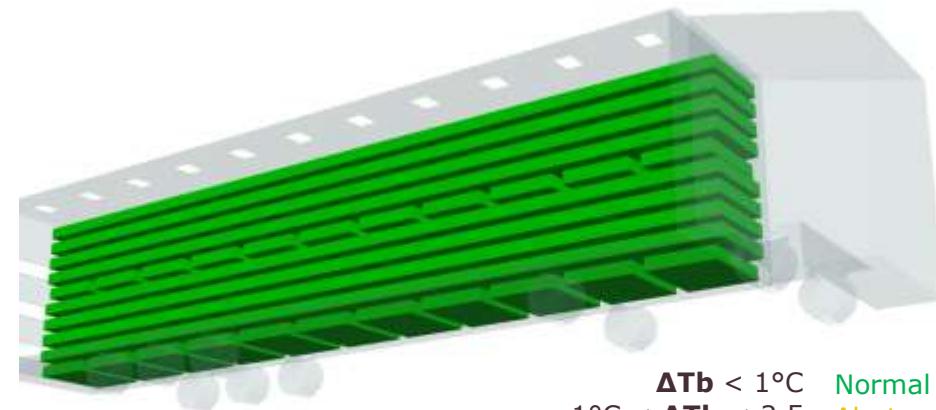
Air velocity



Exposure time



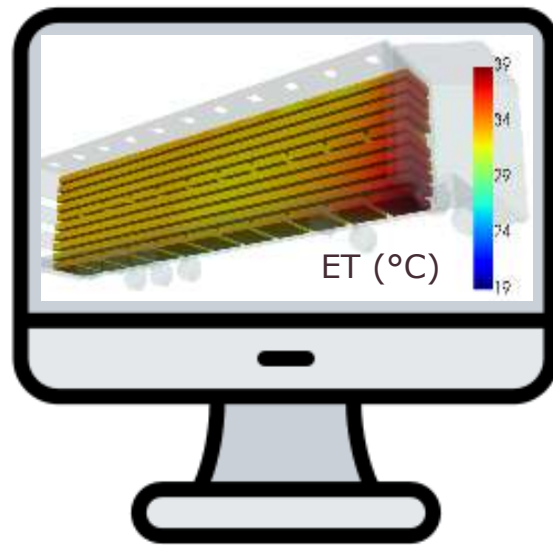
Time = 00 min



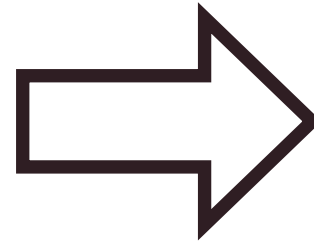
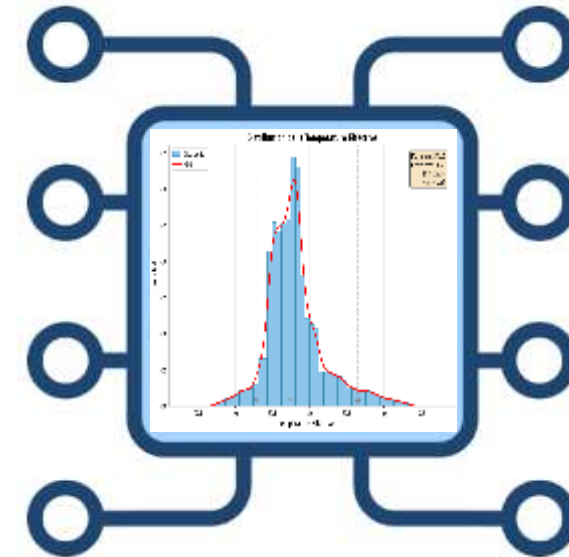
$\Delta T_b < 1^\circ\text{C}$ Normal
 $1^\circ\text{C} < \Delta T_b < 2.5^\circ\text{C}$ Alerte
 $2.5^\circ\text{C} < \Delta T_b < 4^\circ\text{C}$ Danger
 $\Delta T_b > 4^\circ\text{C}$ Urgence



3D CFD model - Main limitation



Several hours per scenario
One weather/density/weight
combination at a time.
**Not practical for the
poultry sector**



A fast surrogate model is
created to predict **Effective
Temperature distribution**
and physiological response in
milliseconds.

Surrogate model - Building the training database

A design of experiments must cover the conditions actually encountered :

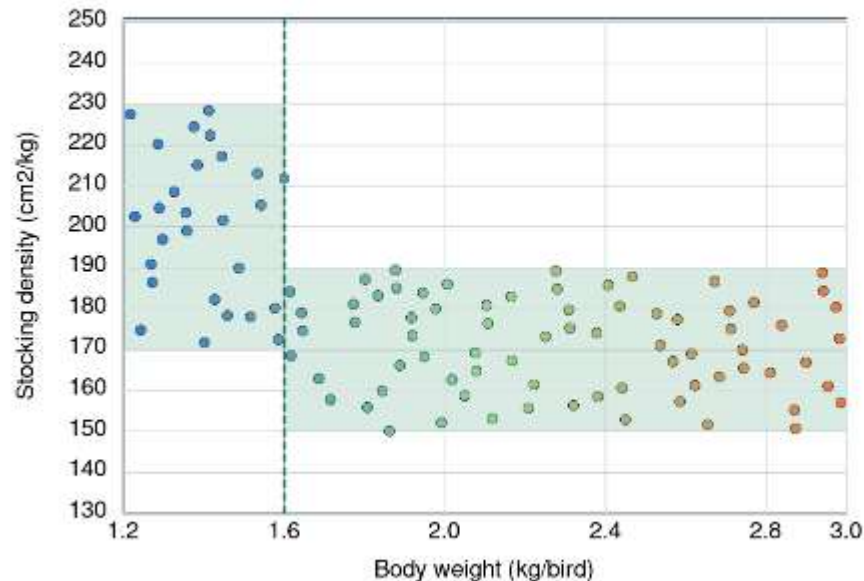
- 100 configurations generated (Sobol sequences)
- 4 months calculation

Temperature
Humidity

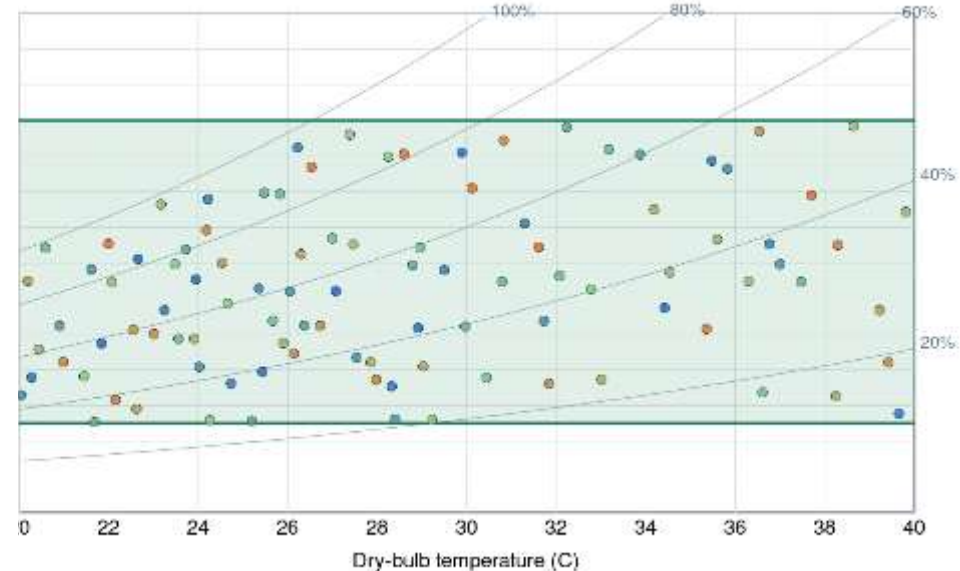
X

Density
Body weight

Body weight and stocking density

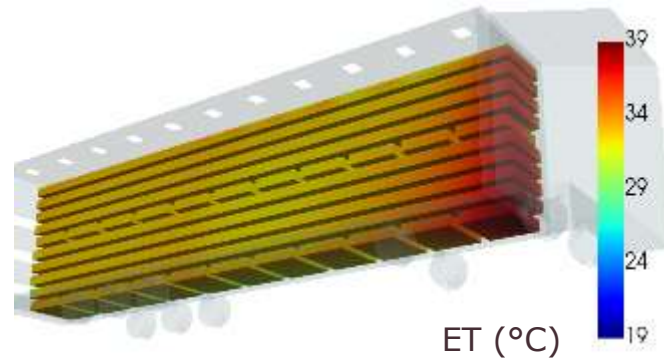
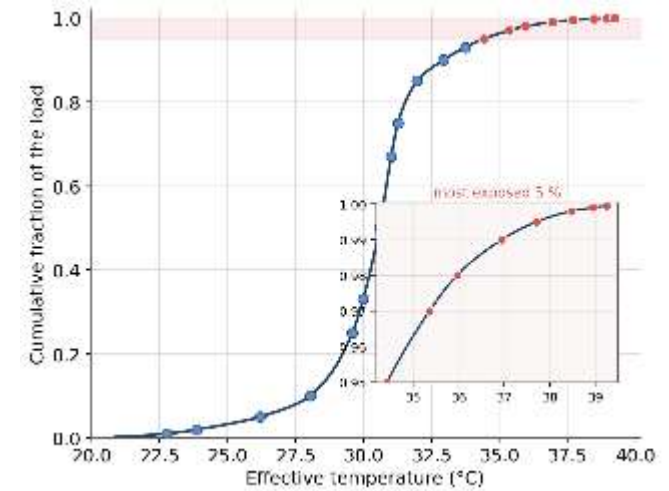


Psychrometric DOE

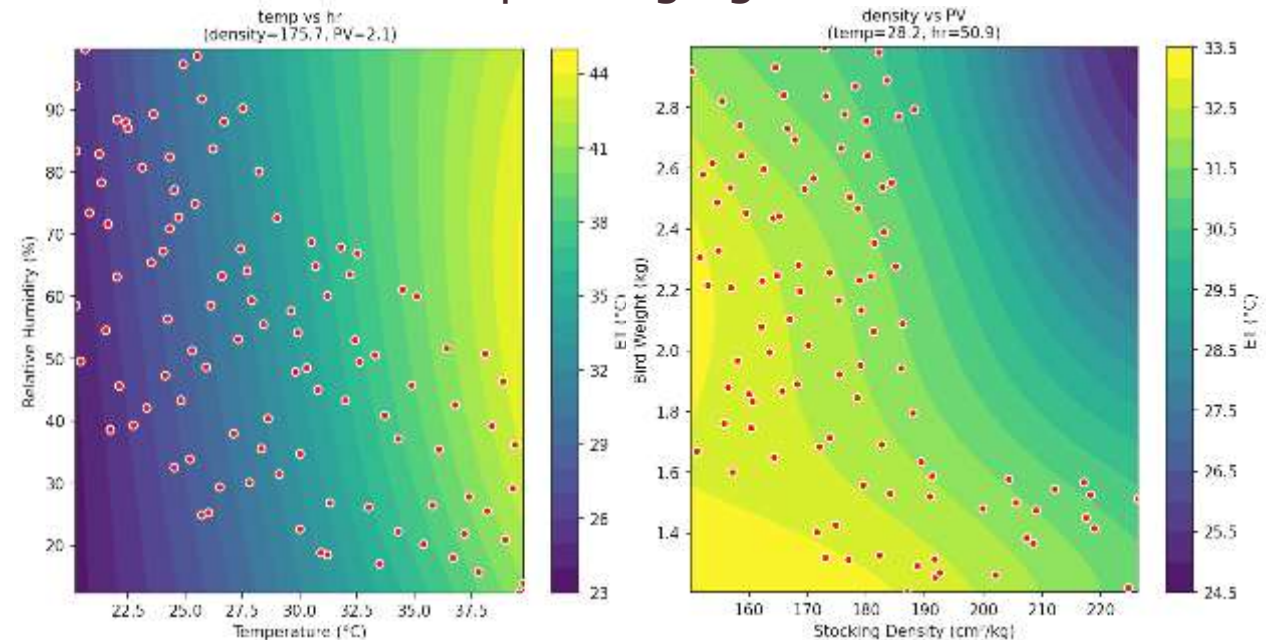


Surrogate model - Principle

- From each CFD solution: 20 ET quantiles, $q01 \rightarrow q99.95$
- One kriging model per quantile, independently trained
- The upper tail is sampled densely : 8 of the 20 quantiles above $q95$
- The spatial map is lost but the exposure distribution is kept

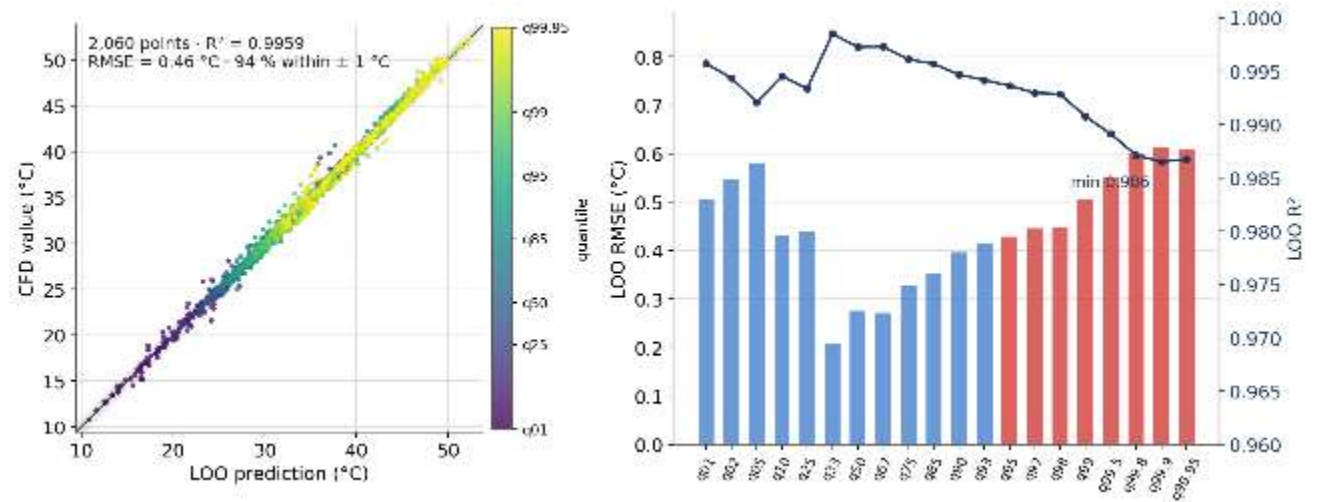


q50 kriging



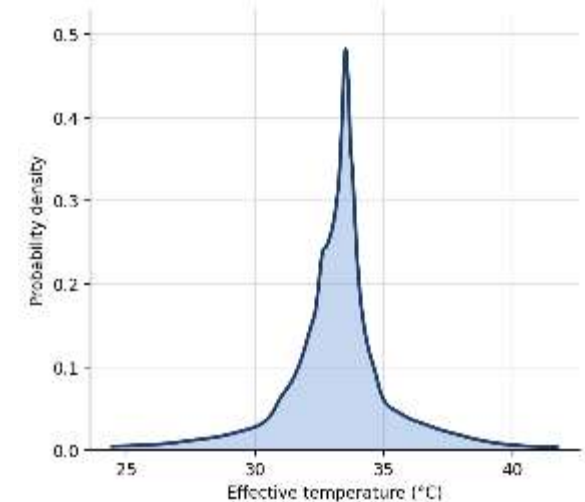
Surrogate model - Validation

- Leave-One-Out Cross-Validation on the 100 scenarios
- $R^2 > 0.985$ across all quantiles
- Prediction time reduced from hours to milliseconds



Exemple :

- $T = 29^\circ\text{C}$
- $\text{RH} = 50 \%$
- $\text{Density} = 160 \text{ cm}^2/\text{kg}$
- $\text{BW} = 1.95 \text{ kg}$

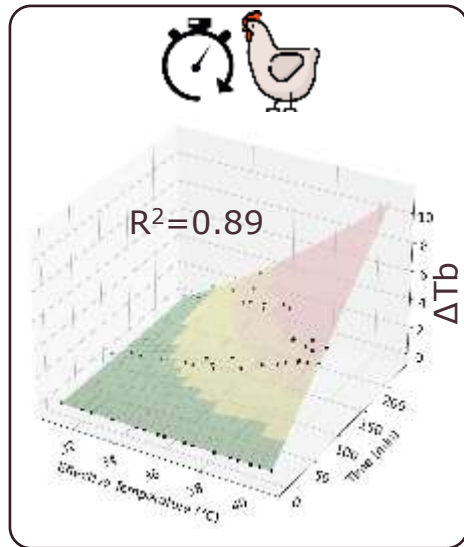
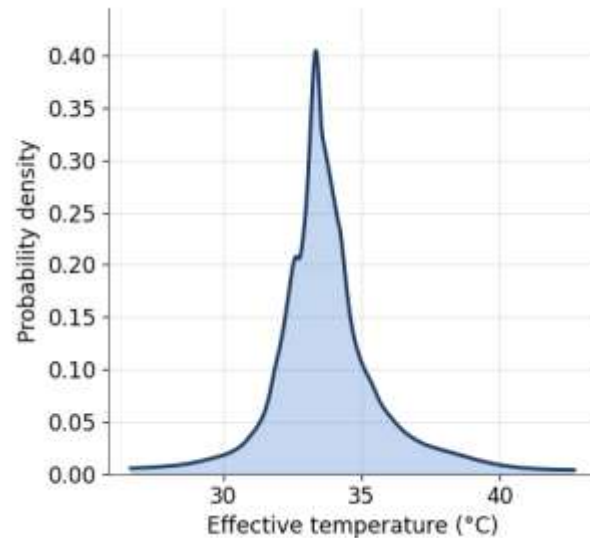
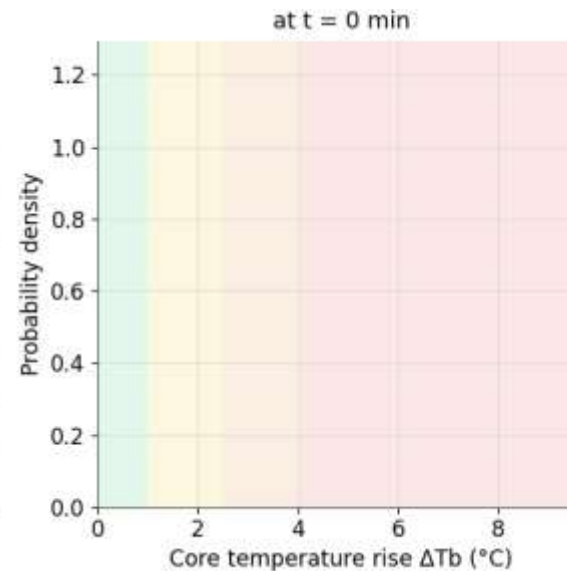
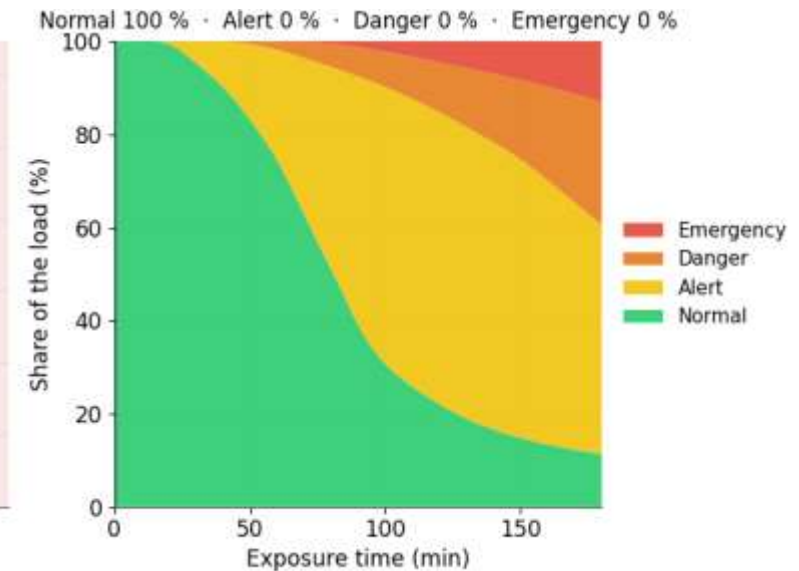


Surrogate model - Stress response

Exemple :

- $T = 29^{\circ}\text{C}$
- $\text{RH} = 50 \%$
- $\text{Density} = 160 \text{ cm}^2/\text{kg}$
- $\text{BW} = 1.95 \text{ kg}$

Exposure time



Webapp

1. Get weather forecast for a location (+48h)



2. Set transportation duration and density

3. Estimate the amount of animal subjected to heat stress at arrival

4. Plan optimal departure



29/06/2026



Conclusion and Future work

- Physics from CFD, speed from kriging: **hours** → **milliseconds**
- Whole distribution predicted, not just the mean, the exposed tail included
- Stress categories as a function of exposure time
- **Operational: density and departure time can be arbitrated before loading**

- Quantile-based surrogacy preserves the exposure of the most vulnerable animals, which a mean-based index cannot, but spatial localisation within the vehicle is lost
- Predicted stress categories are physiologically plausible but not yet validated against field outcomes
- DOA is the natural validation target, but it aggregates loading, handling, transport and lairage, **transport is only one contributor.**





aWISH

ANIMAL WELFARE INDICATORS AT
THE SLAUGHTERHOUSE

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„Best Practices“ to improve broiler welfare – scientific **experts'** vs. **poultry farmers'** perspectives

Maite Jachens, Nicole Kemper, Michaela Fels

Institute for Animal Hygiene, Animal Welfare and Farm
Animal Behaviour,

University of Veterinary Medicine Hannover, Foundation



Funded by
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Introduction



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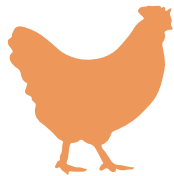


aWISH

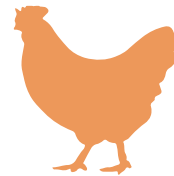
Introduction



- Literature on Best Practices often based on scientific knowledge
- Studies on farmers' views do exist (e.g. Phillips, 2024), but direct comparisons between scientific experts and farmers are scarce



Aim of this study: Comparing scientific experts' **and** farmers' perspectives on “Best Practices” regarding broiler welfare





Literature review to identify “Best Practices”

Databases:
PubMed
Web of Science

Keywords:
“**Broiler**” + AWI

AWI:

- “Footpad Dermatitis”
- “Hock burns”
- “Catching damage”



Identified measures to improve animal welfare were then integrated into two surveys

2 Online Surveys:

1. Survey with animal welfare experts:
 - All aWISH project partners and **project's** expert panel
 - Animal welfare experts from 21 countries



2. Survey with poultry farmers:
 - Farmers from Germany
 - Via company websites, organisations and appeal in German



Footpad Dermatitis / Hock burn

Lowering stocking density on farm below EU legislation/more space allowance per broiler



Slow growing breeds



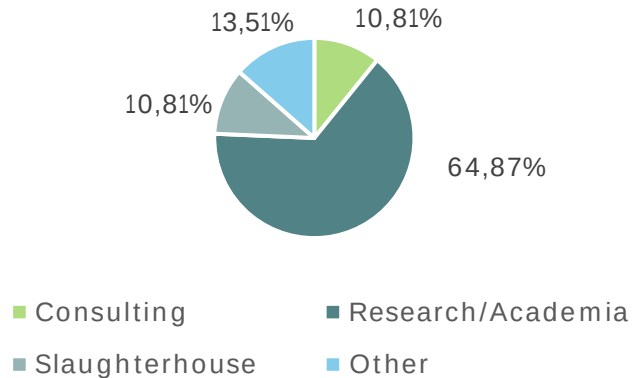
Results



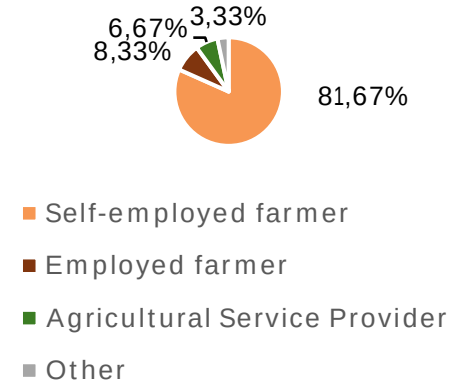
Participants' backgrounds

Experts n=37; Farmers n=60

Background Experts



Background Farmers

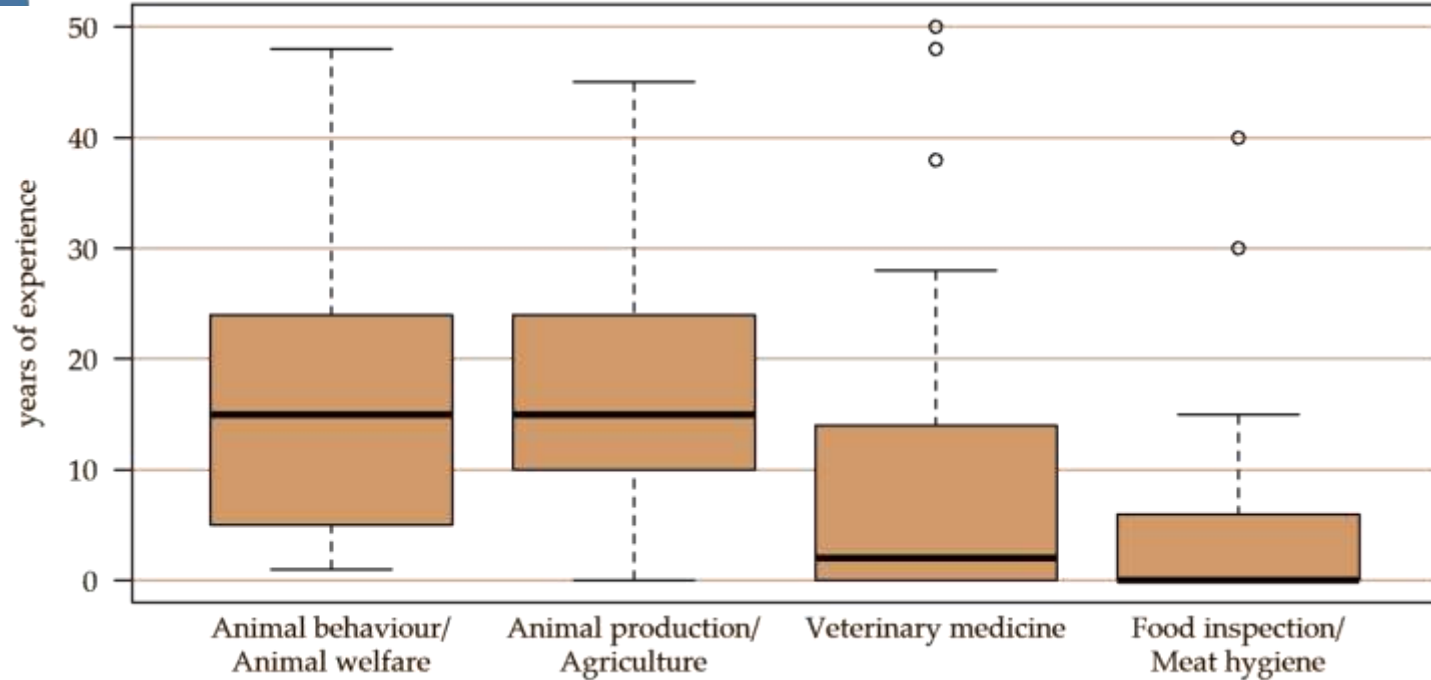


Results



Participants' backgrounds

Years of experience of experts

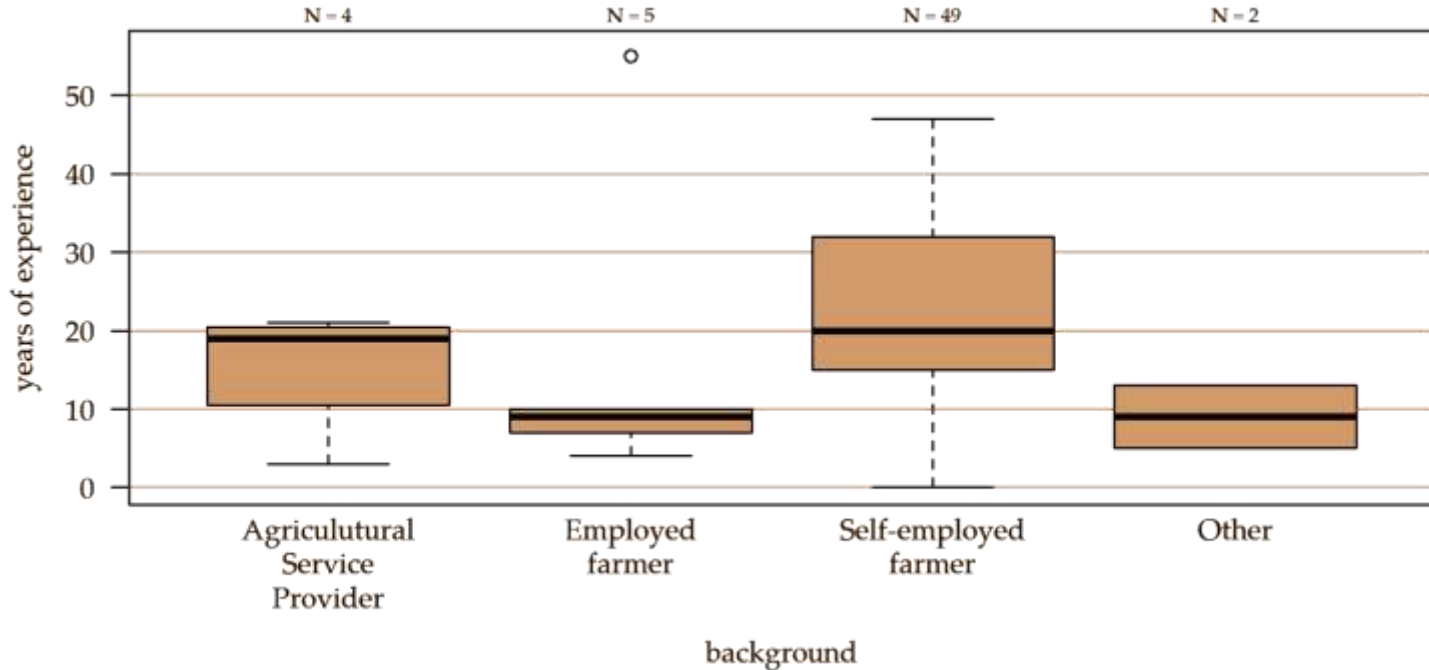


Results



Participants' backgrounds

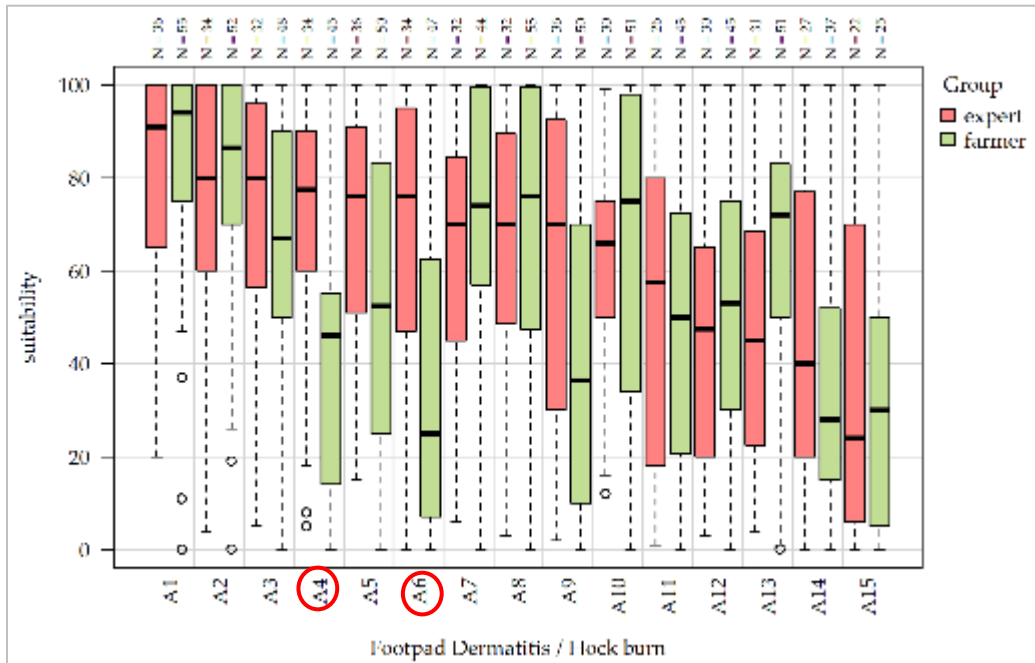
Years of experience of farmers



Results: Farmers vs. Experts



Footpad Dermatitis/Hock



Answer Code	Best Practice
A1	Good ventilation in stables (e.g. ventilation rate)
A2	Height of waterline adjusted to animal size
A3	Age appropriate adjustment of water pressure
★ A4	Litter management (e.g. raking, windrowing, etc.)
A5	Regular replenishment/replacement of litter
★ A6	Slow growing breeds
A7	Small cups or water nipples instead of bell drinkers

★ = $p < 0.05^*$

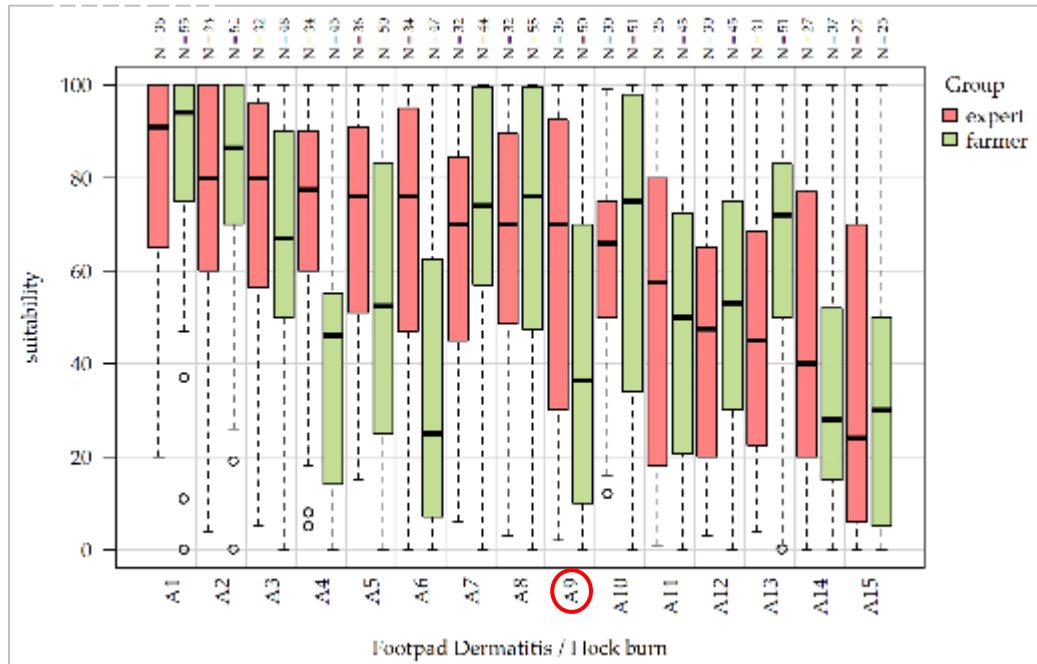
*Mixed linear regression model (fixed effects: Best Practice, Group (farmer or expert), random effect: Participant-ID)



Results: Farmers vs. Experts



Footpad Dermatitis/Hock



Answer Code	Best Practice
A8	Preheating stable/floor prior to arrival of animals
★ A9	Lowering stocking density on farm below EU legislation
A10	Litter other than straw (e.g. pine shavings)
A11	Avoiding high salt content in feed
A12	Feed additives (e.g. biotin, zinc, vitamin D3)
A13	Feed additives to stabilise gut microbiota
A14	Litter amendments (e.g. acidifiers)
A15	Black soldier fly larvae in feed

★ = $p < 0.05^*$

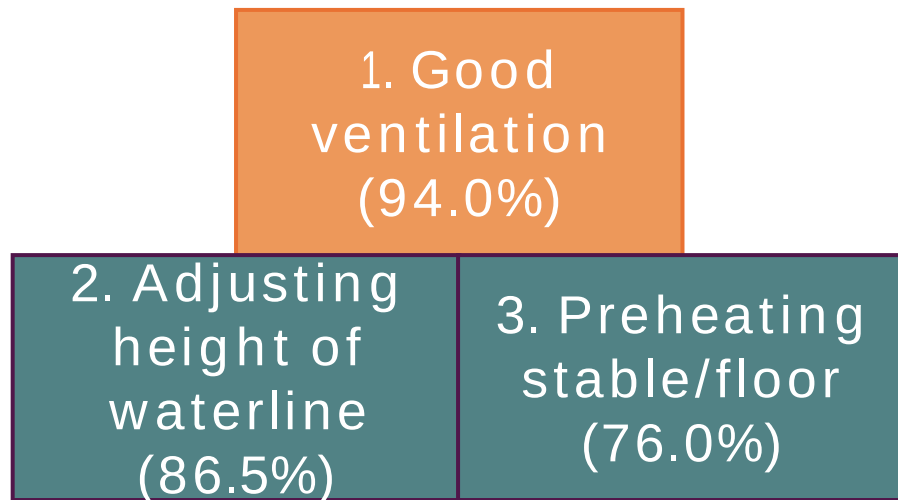
*Mixed linear regression model (fixed effects: Best Practice, Group (farmer or expert), random effect: Participant-ID)



Top 3 Best Practices FPD/HB

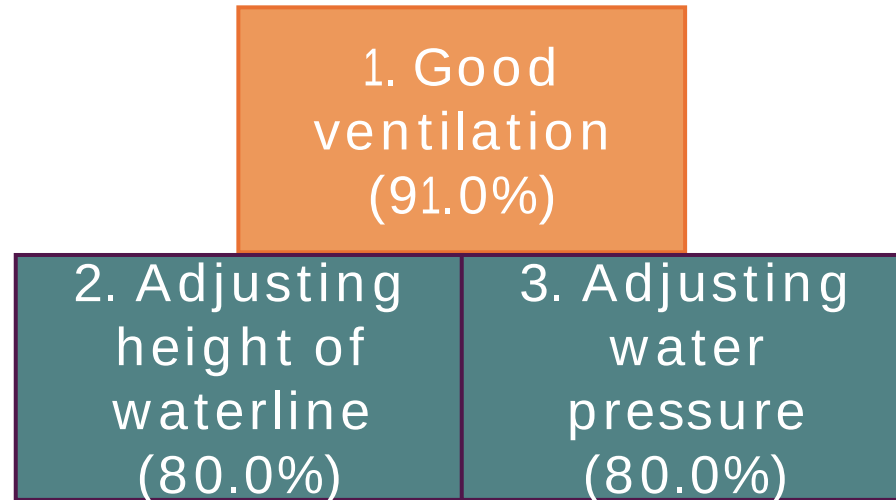


Farmers



Adjusting water pressure: rank 7/15
(67.0%)

Experts



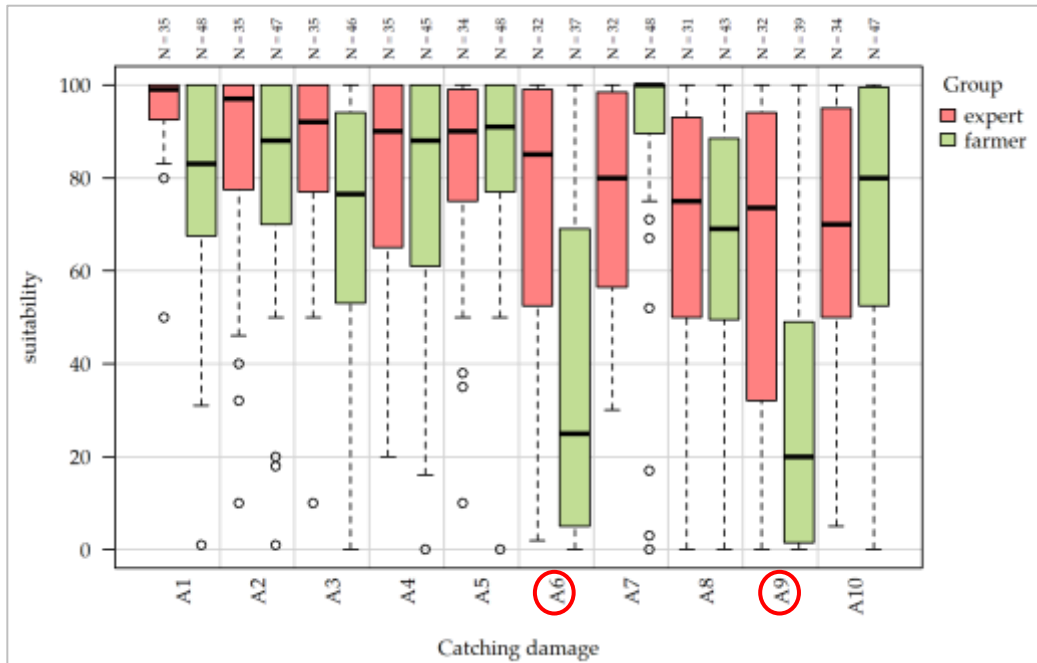
Preheating stable/floor: rank 7/15
(70.0%)



Results: Farmers vs. Experts



Catching damage/injuries



Answer Code	Best Practice
A1	Careful handling
A2	Good condition of crates
A3	Training provided to handling personnel
A4	Avoiding animals hitting the edge of the crate
A5	Handler experience
★ A6	Not picking broilers up by their wings or legs
A7	Low light intensity
A8	Method of catching (manual vs. mechanical)
★ A9	Carrying broilers upright
A10	Catching duration as short as possible

★ = $p < 0.05^*$

*Mixed linear regression model (fixed effects: Best Practice, Group (farmer or expert), random effect: Participant-ID)



Top 3 Best Practices Catching injuries



Farmers

1. Low light intensity
(100.0%)

2. Handler experience
(91.0%)

3. Good condition of crates
(88.0%)

Careful handling: rank 4/10 (83.0%)
Training handling personnel: rank 6/10 (76.5%)

Experts

1. Careful handling
(99.0%)

2. Good condition of crates
(97.0%)

3. Training handling personnel
(92.0%)

Low light intensity: rank 6/10 (80.0%)
Handler experience: rank 4/10 (90.0%)



Conclusion



- Agreement between scientific experts and farmers on most Best Practices
- Similar top ranking practices
- Significant differences → challenges in practical implementation



Dialogue between research and farmers necessary to find Best Practices that are effective while being feasible on farm



Thank you for your attention! Questions?



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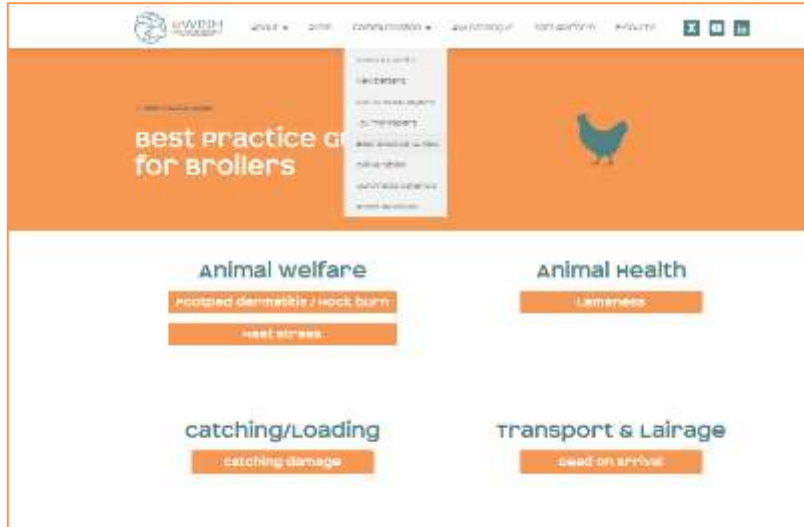


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Best Practice Guides



www.awish-project.eu/best-practice-guides



www.youtube.com/@HEurope_aWISH

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