



Better Training for Safer Food *Initiative*

Training course on “Animal Welfare in pig production”

**Relevance of resource based indicators
for pig welfare assessment**

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EU Legislation

**Council Directive 2008/120/EC of 18 December 2008
laying down minimum standards for the protection of pigs**

**Council Directive 98/58/EC of 20 July 1998 concerning the
protection of animals kept for farming purposes**

National laws (S, D, NL, UK, DK, AU, B, BU)



EU Legislation

List of EU minimum requirements of Directives 2008/120/EC and 98/58/EC (in italics) according to WQ[®] criteria.

Welfare Quality [®] PRINCIPLES	Welfare Quality [®] CRITERIA	EU minimum requirements
Good feeding	Absence of prolonged hunger	<i>Appropriate diet to satisfy nutritional needs</i>
		Feeding at least once a day
		Minimum age of 28 day at weaning (or 21 days)
		Sufficient quantity of fibre for dry sows and gilts
		Feeding system ensuring sufficient food to dry sows and gilts even when competitors are present
		<i>Feeding equipment, designed, constructed and places so that contamination of food and the harmful effects are minimised</i>
	Absence of prolonged thirst	Permanent access to sufficient quantity of fresh water
		<i>Watering equipment, designed, constructed and placed so that contamination of food and the harmful effects are minimised</i>

Welfare Quality [®] PRINCIPLES	Welfare Quality [®] CRITERIA	EU minimum requirements
Good housing	Comfort around resting	Design of farrowing pens (nest flooring, space for suckling)
		Nesting material for farrowing gilts and sows
		Avoidance of continuous noise level as loud as 85 dBA
		<i>No permanent darkness nor without appropriate period of rest</i>
	Thermal comfort	Laying area physically and thermally comfortable, drained and clean which allows all pigs to lie at the same time
		Sufficient solid floored area for resting piglets in farrowing pens
		<i>Air circulation, T, RH to be kept within limits not harmful to the pigs</i>
		<i>Backup and regularly tested alarm systems in case AW is dependent on an artificial ventilation system</i>
		<i>Protection of animals not kept in buildings from adverse climate</i>
	Ease of movement	Lightening 40 lux at least 8 hours/day
		Space allowance
		Minimum size of collective pens for sows and gilts (width 2,8 or 2,4 m for less than 6 individuals)
		Pen design allowing pigs to escape and hide from other pigs in case of mixing unfamiliar groups of weaners and rearing pigs
		No tethers for sows and gilts and limitation of crates for pregnancy

Welfare Quality [®] PRINCIPLES	Welfare Quality [®] CRITERIA	EU minimum requirements
Good health	Absence of injuries	Limitation of slatted floor for pregnant sows and gilts
		<i>No sharp edges or protrusions likely to cause injuries to animals</i>
		Size requirements for concrete slatted floor according to the pig size
		Protection of piglets in farrowing pens
		Availability of adequately sized individual pens to separate pigs at risk of aggression or injured or particularly aggressive
		Limitation of mixing groups of unfamiliar weaners and rearing pigs
		Pen design allowing pigs to escape and hide from other pigs in case of mixing unfamiliar groups of weaners and rearing pigs
	Absence of diseases	Thoroughly cleaning of sows before housing them in farrowing crates
		<i>Materials in contact with animals must be capable to be thoroughly cleaned and disinfected</i>
		Availability of adequately sized individual pens for sick pigs
		Minimum age at weaning (diarrhoea)
		<i>Dust levels and gas concentrations within limits not harmful for animals</i>
		<i>Protection of animals not kept in buildings from predators and risk for their health</i>
		<i>Record of medical treatments</i>
	Absence of pain induced by management procedures	No routinely reduction of corner teeth
		No routinely docking of a part of the tail
		No castration by other means that tearing the tissues
		Nose ringing in outdoors systems only

Welfare Quality® PRINCIPLES	Welfare Quality® CRITERIA	EU minimum requirements
Appropriate behaviour	Expression of social behaviour	No tethers for sows and gilts and limitation of crates for pregnancy
		Visual contact with other pigs (except for farrowing stage)
		Access to a sufficient quantity of material to enable investigation and manipulation (general requirement)
	Expression of other behaviours	Nesting material for farrowing sows
		<i>Sufficient number of staff professionally skilled</i>
	Good human-animal relationship	<i>Daily inspection on animals and of automated or mechanical equipment essential for health and well being of the animals</i>
		Mandatory instructions and guidance (training) for persons attending pigs
	Positive emotional state	

Scientific references

**The welfare of intensively kept pigs. Report of the Scientific Veterinary Committee
Adopted 30 September 1997**

**Opinion of the AHAW on a request from the Commission related to welfare aspects of
the castration of piglets update. 2004 Update 2005**

**Opinions of the Scientific Panel on Animal Health and Welfare (AHAW) on a request
from the Commission related to welfare of weaners and rearing pigs: effects of
different space allowances and floor. 2005**

**Opinion of the AHAW on a request from the Commission related to animal health and
welfare in fattening pigs in relation to housing and husbandry. 2007**

**Opinion of AHAW on animal health and welfare aspects of different housing and
husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned
piglets. 2007**

**Opinion of AHAW on the risks associated with tail biting in pigs and possible means to
reduce the need for tail docking considering the different housing and husbandry
systems. 2007**

**Animal welfare risk assessment guidelines on housing and management. Technical
report submitted to EFSA. WUR 2010**

Scientific references

Preparatory work for the future development of animal based measures for assessing the welfare of pigs (external reports). 2011

Report 1: Preparatory work for the future development of animal based measures for assessing the welfare of sow, boar and piglet including aspects related to pig castration.

Report 2: Preparatory work for the future development of animal based measures for assessing the welfare of weaned, growing and fattening pigs including aspects related to space allowance, floor types, tail biting and need for tail docking.

Opinion of the AHAW on the use of animal-based measures to assess welfare in pigs. 2012.

Opinion of AHAW on a multifactorial approach on the use animal and non animal-based measures to assess welfare of pigs. 2014.

AW assessment systems

Two groups of systems:

- based primarily on diagnostic parameters measured on the animal, such as physiological, medical, behavioral, production (animal-based systems)
- based primarily on technical parameters concerning the husbandry environment: housing system, building features, space allowance, type of flooring, microclimate control, hygiene level, equipment and management (farm index systems or resource-based systems)

ABMs vs RBMs

- Animal-based measures, identified on the basis of scientific evidence, can be used effectively in the evaluation of the welfare of on-farm pigs in relation to laws, codes of practice, quality assurance schemes and management.
- Non-animal-based measures can be used when the association between them and the welfare outcome is strong and when they are more efficient than animal-based measures as a means to safeguard welfare.
- Both animal-based and non-animal-based measures can be useful predictors of welfare in pigs. In order to assess welfare, a wide range of measures is needed.

(EFSA, 2012)

AW & environment

air speed

light

toxic gases

humidity

dust

temperature

space allowance

flooring

housing
system

hygiene

group size

feeding and
drinking

social
relationship



Microclimate control

Air circulation, temperature, relative humidity and gas and dust concentrations, must be kept within levels not harmful for the animals



Microclimate control

Temperature is the most important and widely investigated component of microclimate

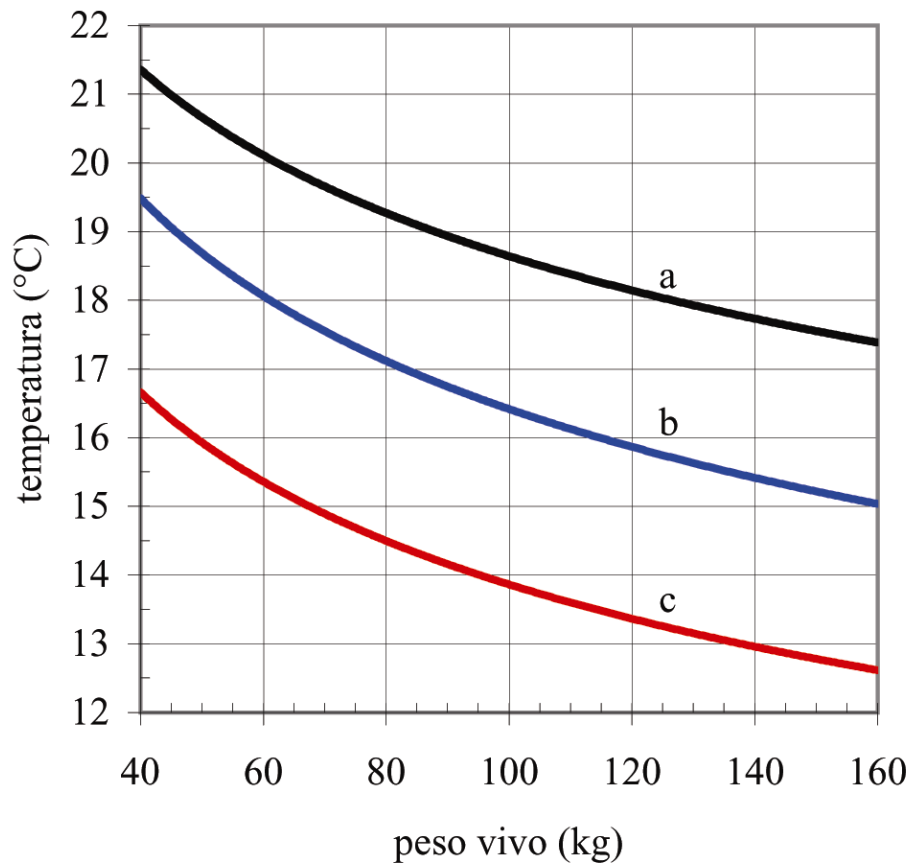
Correlations have been demonstrated between the indoor air temperature and feed consumption, daily growth, feed conversion rate, health status and reproductive activity

Temperature (°C)	Feed consumption (kg/d per pig)	Daily growth (g/d per pig)	Feed Conversion Rate
10	3,50	800	4,37
15	3,15	790	3,99
20	3,22	850	3,79
25	2,63	720	3,65
30	2,21	450	4,91
35	1,51	310	4,87

Font: Nichols *et al.*, 1980.

The mean radiant temperature takes into account the heat exchanges by radiation and is measured with special instruments called Globe thermometers

Microclimate control



**Air temperature
suggested for fattening
pigs in collective pens**

a=slatted floor

b=solid floor

c=straw bedded floor



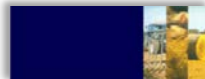
European
Commission

Table - Suggested ranges of temperatures for breeding pigs, piglets and weaners (CRPA, 2004)

Category	Temperature (°C)
Boar in individual pen:	
- partially slatted floor	18÷20
- solid floor	16÷18
- straw bedded floor	14÷16
Pregnant sow:	
- individual housing	19÷20
- group housing, partially slatted floor	17÷18
- group housing, solid floor	15÷16
- group housing, straw bedded floor	13÷14
Lactating sow:	
- slatted floor	18÷20
- straw bedded floor	16÷18
Piglets (nest area):	
- at birth	32÷35
- 1 st week	28÷30
- 2 nd week	26÷28
- 3 rd week	24÷26
- 4 th week	22÷24
Weaners (start):	
- slatted floor	27÷28
- partially slatted floor	26÷27
- straw bedded floor	21÷22
Weaners (end):	
- slatted floor	20÷22
- partially slatted floor	18÷20
- straw bedded floor	16÷18

Air temperature measured at the animal height

Consumers,
Health And Food
Executive Agency



Microclimate control

The rate of air humidity is an environmental parameter that can have a major influence on animal welfare.

Absolute humidity in the pig house (AH), is the amount of steam in grams contained in 1 m³ of air.

It is affected by:

- **external humidity**
- **evaporation of water inside the building (water troughs, tanks, wash water, etc.)**
- **evaporation from pigs**
- **ventilation flow rate**

Microclimate control

Relative humidity (RH) is the ratio between the actual amount of steam in the air at a given temperature and the maximum possible amount (saturated steam) at the same temperature.

Example: $t_i = 15^\circ\text{C}$, $AH = 7,1 \text{ g/m}^3$;

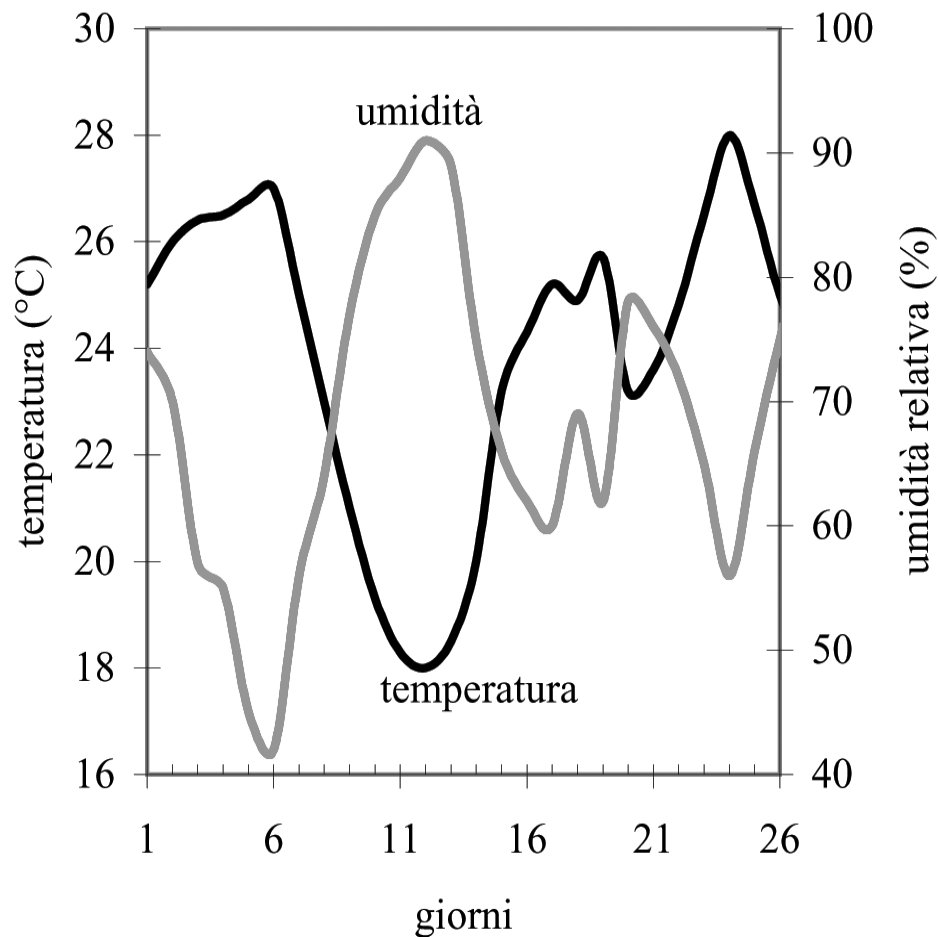
max quantity of steam in the air at $t_i = 15,25 \text{ g/m}^3$;

$$RH = 7,1 / 15,25 \times 100 = 46,5\%$$

Microclimate control

Temperature (°C)	Relative Umidity (%)				
	70	75	80	85	90
-4	2,40	2,57	2,79	2,91	3,07
-2	3,00	3,21	3,43	3,64	3,86
0	3,56	3,82	4,05	4,34	4,61
2	4,12	4,42	4,66	5,02	5,33
4	4,69	5,03	5,30	5,72	6,07
6	5,30	5,68	5,99	6,45	6,85
8	5,96	6,38	6,74	7,25	7,70
10	6,69	7,16	7,58	8,14	8,63
12	7,51	8,04	8,53	9,13	9,68
14	8,44	9,03	9,61	10,25	10,86
16	9,49	10,16	10,84	11,53	12,21
18	10,68	11,44	12,23	12,98	13,75
20	12,03	12,88	13,80	14,63	15,49
22	13,55	14,51	15,58	16,48	17,45
24	15,25	16,35	17,57	18,57	19,66
26	17,16	18,40	19,80	20,91	22,14
28	19,27	20,68	22,27	23,51	24,90
30	21,62	23,20	25,01	26,40	27,96

Microclimate control



**Air T and RH
measured in a
fattening unit**

Microclimate control

- Air speed (wind) causes an increase of heat dispersion by convection
- Moreover, air movement promotes evaporation because removing the layer of air around the body and replacing it with drier air



Microclimate control

The effects on pigs are strictly correlated to the air temperature inside the house

WINTER: the increase in air speed of 0.1 m/s corresponds to a decrease of about 1° C of temperature perceived by the animal (attention to smaller pigs and those reared individually).

SUMMER: increased air speed is favorable because it reduces thermal stress by accelerating heat loss and evaporation from the skin

Microclimate control

For indoor kept pigs microclimate control happens in two steps:

- step 1: from the pig to the indoor environment around it (physiological aspects of animal production are relevant as well as the mechanisms that the pig can put in place to protect itself against cold and hot)**
- step 2: relationship between the indoor environment and the outdoor environment, mostly in terms of thermal balance (thermal insulation and ventilation are relevant)**

Microclimate control

The pig is an homeotherm animal, that needs to maintain a constant level of its internal body temperature (about 39°C) in order to safeguard the body's vital functions. To achieve this, the animal must balance the production and dispersion of heat; the heat produced for its maintenance (Φ_m) and production (Φ_p) must be equal to the total heat lost (Φ_T):

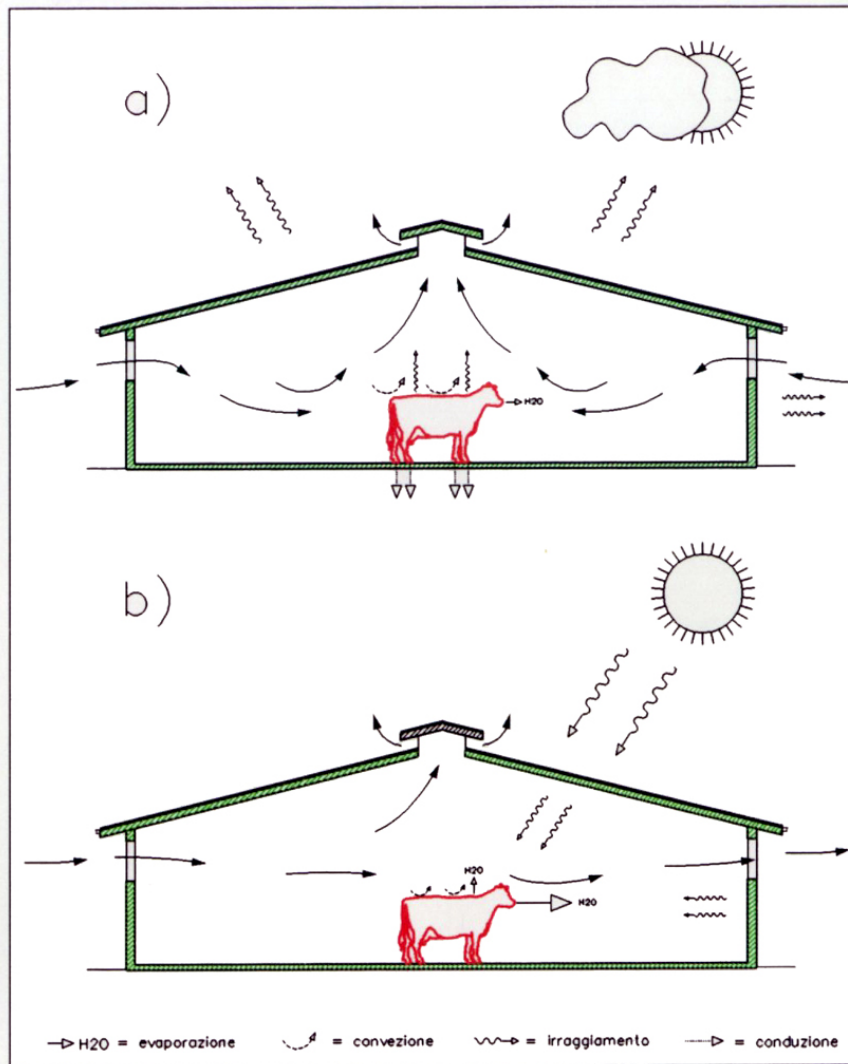
$$\Phi_m + \Phi_p = \Phi_T$$

Microclimate control

To comply with the heat equation it is necessary that the heat is dissipated through the body of the pig, this can be done basically in two ways: as sensible heat (Φ_s) and as latent heat (Φ_l):

$$\Phi_T = \Phi_s + \Phi_l$$

HEAT



Sensible heat:

- convection
- conduction
- radiation

Latent heat

(1 l/h = 0,681 kWh)

Microclimate control



Essential factors:

- orientation
- insulation
- ventilation
- shading
- cooling
- heating

Microclimate control

Ventilation is very important because:

- replaces toxic gases with oxygen
- removes steam and heat
- removes dust

Maximum suggested concentrations of noxious gases and dust in animal houses

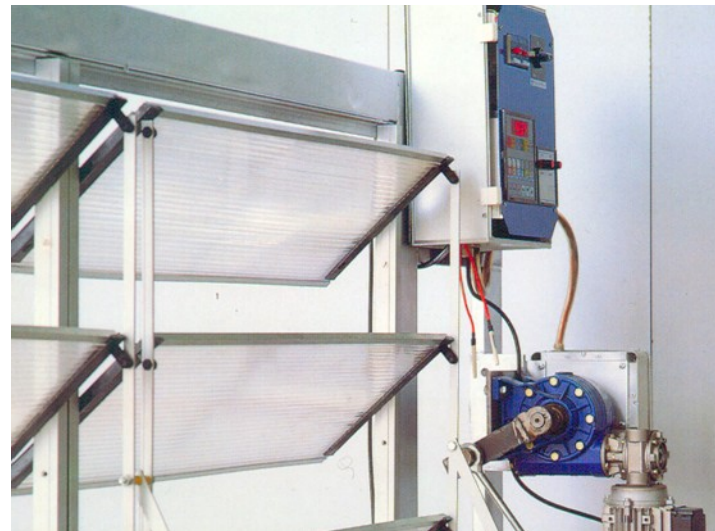
Exposition	NH ₃ (ppm)	CO ₂ (ppm)	H ₂ S (ppm)	Tdust mg/m ³	Rdust mg/m ³
Prolonged	10	2.500	2,5	10	5
Short	25	5.000	10		

(Barbari *et al.*, 1995)

Microclimate control

Natural ventilation: the air movement is due to natural physical phenomenon (difference of temperature, different height between incoming and outgoing air, wind)

Mechanical ventilation: the air movement is forced by the action of fans



Microclimate control

Minimal ventilation flow (winter) **and maximal ventilation flow** (summer) must be calculated, according to the load of animals and to indoor and outdoor reference conditions

Minimal and maximal surfaces of air inlet and outlet must be established to allow effective natural ventilation and good thermal comfort

Microclimate control

Minimum (V_{\min}) and maximum (V_{\max}) ventilation flows for pig category and live weight (CRPA)

Pig category and live weight	$V_{\min}^{(1)}$ (m ³ /h)	V_{\max} (m ³ /h)
Piglet 5 kg lw	3	18
Piglet 10 kg lw	5	29
Piglet 20 kg lw	7	45
Piglet 30 kg lw	9	60
Grower 40 kg lw	11	74
Grower 60 kg lw	14	92
Finisher 80 kg lw	16	104
Finisher 100 kg lw	17	115
Finisher 120 kg lw	18	120
Finisher 160 kg lw	19	135
Dry gilt 140 kg lw	19	135
Pregnant gilt 190 kg lw	25	185
Dry sow 200 kg lw	21	150
Pregnant sow 220 kg lw	25	185
Lactating sow 200 kg lw + suckling piglets	32	230
Boar 200 kg lw	22	155

⁽¹⁾ $T_e = -4^\circ\text{C}$; $RH_e = 90\%$

Farm index systems

- estimate the potential of farming methods, structures and management to provide a certain level of welfare for farmed animals
- are based on technical parameters established and developed through research, experimentation and experience of farmers and technicians, besides the current legislation
- are not contrary or alternative of animal-based systems, but simply offer a different service

The best-known index systems in Europe are the Austrian TGI (ANI = Animal Needs Index).

Farm index systems

Since 1995 TGI 35L official welfare assessment system for organic farms in AU

TG 200 is an advisory tool on organic farms in DE

Both TGI systems rely on the application of design and to a lesser degree on management criteria and use only few semi-quantitative animal-based indicators.

Defined areas of influence either to animals' freedom to express different behaviour pattern (TG 200) or to functional areas (TGI 35L), as well as to hygiene and management factors (TGI 200), or light, air and stockpersonship (TG 35L)

Total index and area scores are expected to be positively correlated with the quality of husbandry conditions

IBA farm index systems

Developed by CRPA and University of Florence (DIAF) within an experimental project funded by:

- Emilia-Romagna Region, Department of Agriculture (L.28/98)
- ASSER (Organization of pig producers in Emilia-Romagna)
- Parma ham Consortium

It is a farm index system (on-farm index system) based primarily on farming resources (resource-based system), which incorporates criteria and methodology of the already existing IBA Cattle (CRPA, UniBo, UniFi).

IBA check lists

The main investigated features:

- husbandry systems and housing structures
- facilities for quarantine and isolation
- microclimate control
- food and drinking water
- hygiene, health and animal behavior
- inspection of animals and equipment
- stockmanship



IBA has been used to establish lists of priority for pig farms accessing to incentives for improved animal welfare of Measure 215 of Rural development programme of RER

Scientific references

EFSA Opinions

CIGR - 2nd Report of Working group on climatization of animal houses. State University of Gent. Belgium, 1992.

CIGR - 4th Report of Working group on climatization of animal houses. Pedersen S. & Salvik K. Denmark. 2002.

ASABE - Dimensions of livestock and poultry. ASABE Standards.

IBA is not a tool for controlling "compliance" with AW rules (this activity is the responsibility of official veterinary services), but obviously takes into account the AW rules

IBA is not the tool to assess the welfare of the animals, but one of the possible ways to approach this complex issue

IBA is a tool to advice farmers aiming to identify farming weaknesses, allowing the farmer to make targeted interventions in his farm in order to improve the welfare of their animals and farm profitability as well

Conclusion 1

Animal welfare may help pig farmers to improve housing and husbandry techniques in order to improve health status and productive performances too

THE OPPORTUNITY: consider animal welfare even beyond the minimum requirements of the law, as a basic condition to improve farm efficiency and to differentiate livestock production

THE THREAT: See this issue only as a further complication of the rules imposed on farms

Conclusion 2

Comparison between outcomes of RB and AB assessement for the same criteria and circumstances will be welcome to understand:

- how much ABM are likely to be useful to check compliance of pig farms with AW rules
- how much housing systems and management (RBM) affect the welfare of pigs (ABM) in order to collect useful information for designing and testing innovations in terms of animal friendly housing systems

Thanks for your attention





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