Comparison of various housing systems for laying hens

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In comparing various housing systems it is always a problem to provide figures. They suggest a level of precision that can not be met. There are many factors causing figures to be slightly different under different circumstances. Some very obvious factors are:

- Regional differences: countries and even regions in countries may differ in climate, feed composition, farm size and management, resulting in a large variation in results.
- Beak trimming: in situations where non-trimmed birds are used, the risk for injurious pecking behaviour is much higher, often resulting in higher mortality, worse feather cover and thus higher feed consumption. At least non-trimmed birds cause a much larger variation in results.
- Different genotypes will have different technical results. Also, given a certain housing system, some genotypes are performing better than others.

As a consequence it would be better not to give single figures, but provide a range. However, this has two disadvantages: 1. for giving a well documented range a lot of figures are needed; 2. it can be expected that the variation is so large, that the ranges will overlap and no clear conclusions can be drawn.

Still, in the poultry industry housing and management is rapidly changing due to legislation and consumer demands. In making the right choices both the industry and legislative bodies have a need to get a clue on pros and cons of various housing systems, how they relate and what can be expected from a certain system. To meet this need the following tables are composed. Where possible references are given. If no clear reference is available, an expert opinion is given.

Scientifically the term "enriched cage" is not correct as it is not yet proven that the extra elements in the cages really are enrichments. Therefore, the term "furnished cage" is preferred among scientist. However, as in the European legislation and in the industry the term "enriched cage" is used, it was decided to use this term in the tables as well and thus prevent any possible confusion.

The following tables should be used as guidelines and as start of discussion. Please keep in mind that figures do vary and also change when housing and management evolve to higher standards.

Overview and weighing[1)] various housing systems, part 1: health and behaviour

Composed by **T.G.C.M. van Niekerk**, Animal Sciences Group (ASG), Wageningen University and Research Center (Wageningen UR), the Netherlands

	Conventional cages (5 hens /cage)	**Small enriched cages** (≤ 15 hens /cage)	**Large enriched cages** (> 15 hens /cage)	**Non-cage systems without free-range**	**Non-cage systems with free-range**
HEALTH					
Parasites					
Worms	++	+	+	0	-
Red mites	0	0	0	0	0
Flies [2)]	+	+	+	+/-	+/-
Viral and bacterial infections					
Salmonella	+	0	0	0	-
IB	0	0	0	0/-	0/-
E.Coli	+	+	+	0	-
AI	+	+	+	+	-
Other					
Mortality	+	+	+	0	-
Burned out [3)]	++	+	+	0	-
Bone strength	--	-	0	+	+
Bone fractures [4)]	-	-	-	-	-
Fresh climate (NH3, dust)	+	+	+	0/-	0
BEHAVIOUR					
Moving	--	-	0	+	++
Resting at day time [5)]	-	0	0	+	+
Resting at night	-	+	+	+	+
Nesting	--	+	+	+	+
Dust bathing [6)]	--	0/-	0/-	+	++
Scratching [7)]	--	-	0/-	+	++
Individual recognition	+	+	+	-	-
Synchronisation behaviour [8)]	0/-	0/-	+/0	+/0	+/0
Cannibalism/pecking in birds with trimmed beaks	+	+	0	0	0/+
Injurious pecking in birds with intact beaks	0	0	0	-	0/+
OTHER					
Bird density	--	-	0/-	0	0/+
Group size	+	+	+/0	-	-
Smothering	+	+	+	0	0

1) *++ = very good, + = good, 0 = neutral, - = bad, -- = very bad; Table derived from table in Dutch report: LEI report 2.07.10. Ban on enriched cages for layers in the Netherlands. The Hague. www.lei.wur.nl*
2) *Flies can be a problem in none-cages systems without manure removal, in systems with manure belts it usually is not a problem.*
3) *Burn-out: these birds produce well in the beginning, but do not eat enough and thus get into a negative energy balance. This results in the end in very skinny birds, insufficient production and higher mortality. Birds that have gained sufficient bodyweight in the rearing period will not have this problem easily. In cages burned-out birds hardly occur.*
4) *Bone fractures can occur during the laying period due to accidents. Data from a field survey in the UK show that it is a problem in all housing systems.*
5) *In enriched cages resting behaviour at day time can easily be disturbed by other hens.*

6) Possibilities for dust bathing behaviour are depending on the type of litter provision.
7) Possibilities for scratching behaviour is limited in systems with small sized litter provisions, especially if they are in an elevated position. A litter mat or low positioned box usually do allow some scratching behaviour;
8) Synchronisation of behaviour is in small enriched cages not always possible: simultaneous eating is possible, but dustbathing and nesting behaviour can not be performed simultaneously due to the limited size of the provisions. In large enriched cages sychronisation of behavior is better possible, but also depends on the facilities provided. Enriched cages with litter mats usually offer fairly good opportunities for synchronisation of behavior, but the large group size will counteract this.

Overview and weighing[1)] various housing systems, part 2: legislation, production and other aspects

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	Conventional cages (5 hens /cage)	**Small enriched cages** (≤ 15 hens /cage)	**Large enriched cages** [2)] (> 15 hens /cage)	**Non-cage systems** [3)] **without free-range**	**Non-cage systems** [3)] **with free-range**
TECHNICAL DETAILS HOUSING			**(minimum standards in Europe, laid down in EU-Directive 1999/74)**		
Dimensions					
Usable area (cm^2/hen) [4)]	550	750	750 (D/NL: 800)	1111	1111 + 4m free range
Minimal height (cm)	40 (35) [5)]	45 (20) [5)]	45 (20) [5)] (D/NL: 60)	45	45
Minimal size (cm^2)	-	2,000	2,000 (D/NL: 25,000)	-	-
Furnishment					
Perch (cm/hen)	-	15	15	15	15
Nest	-	present	present (D/NL: 90 cm^2/hen)	1 per 7 hens or 83 cm^2/hen	1 per 7 hens or 83 cm^2/hen
Litter (cm^2/hen)	-	present	present (D/NL: 90)	250	250
Feed trough (cm/hen)	12	12	12	10 (round: 4)	10 (round: 4)
Claw shorteners	present	present	present	-	-
PRODOCTION RESULTS				**(Brown layers, Dutch data [6)])**	
Egg production					
Laying period (days)	390	390	390	385	375
No. eggs / hen housed	329	329	329	320	306
kg egg / hen housed [7)]	20.6	20.6	20.6	20.0	19.1
Egg quality					
% 2nd grade eggs [8)]	+	+	+/0 [9)]	+/-	+/-
% floor eggs	na	(2-5) [10)]	(2-5) [10)]	2	3
Bacterial contamination	+	+	+/0	0	0
Feed conversion ratio [7)]	2.05	2.05	2.05	2.28	2.33
Mortality (beak trimmed hens)	6	6	6	9 (large variation)	11 (large variation)
OTHER FEATURES					
Environment					
Dust [11)] (gram/henplace/year)	5.4	5.4	5.4	61.0	61.0 +…
Ammonia emission [12)] (gram/hen/year)	12 - 42	30	30	Aviary: 25-90 Barn/deep litter: 106-315	Aviary: 25-90 Barn/deep litter: 106-315 Range: + 18
Labour					
Automation	++	+	+	0	0
Hens / full time worker	60,000	55,000	55,000	35,000	25,000
Working conditions	++	+	+	-	-
Management					
Floor eggs [13)]	++	+	+	-	-
Flexibility of work	++	+	+	-	-
Production cost [14)] (conventional cage = 100%)	100	108	108 (D/NL: 110)	120-125	135-145

1) + = good, 0 = neutral, - = bad

2) D/NL: Germany and The Netherlands have set more strict National legislations for enriched cages, resulting in a system called "colony system"

3) *Non-cage systems: Barn/deep litter = single level (partly slatted, partly littered floor); Aviary = multi-level (stacked elevated floors, EU-Directive 1999/74 states max. 4 levels)*
4) *EU-Directive 1999/74: 'usable area' means: an area at least 30 cm wide with a floor slope not exceeding 14 %, with headroom of at least 45 cm. Nesting areas shall not be regarded as usable areas.*
5) *Figure given is minimum height for 60% of the cage (conventional cage) or for 600cm^2 (enriched cages); figure between brackets is minimum height for the additional area*
6) *Dutch data, published in KWIN 2009/2010 (Quantitative information animal husbandry. Animal Sciences Group of Wageningen UR. Lelystad. August 2009); no official data available for enriched cages, so these are derived from the cage figures, combined with research results and preliminary experiences on commercial farms.*
7) *hens need more energy for movement in non-cage systems, so either egg weight is lower or feed intake is higher*
8) *2nd grade eggs: dirty eggs, eggs with hair cracks, broken eggs, de-coloured shells, odd shapes*
9) *In large enriched cages there is more risk for eggs to roll over dirty surfaces and thus more risk for contamination of eggs; there is a large variation due to management and design of the system*
10) *In enriched cages floor eggs roll onto the same egg belt as nest eggs and do not cause extra labour. Floor eggs may have a higher risk for contamination with manure.*
11) *Calculated figures (Groot Koerkamp, P.W.G., G.H. Uenk en H. Drost. 1996. Emission of respirable dust by Dutch Animal Husbandries. A&F report 96-10 (Dutch report)); as no data were available for enriched cages it was set at the same level as conventional cages; depending on the amount of litter provided it may be slightly higher.*
12) *Figures from Dutch research, as used in Dutch legislation; variation is due to variation in manure drying techniques. Figures for all cage models are based on a situation with belts and manure drying systems. Figures for aviaries are also based on situations with manure belts. For the free range area no official figures are available; a preliminary study indicated 17.5 grams/hen/year (Aarnink, A.J.A., J.M.G. Hol, A.G.C. Beurskens, M.J.M. Wagemans, 2005. Ammonia emission and mineral deposition in the free range area of laying hens. A&F-report 337 (Dutch report))*
13) *Although floor eggs in enriched cages roll onto the egg belt and do not cause extra labour, the extra furnishment does justify a regular extra check on eggs get stuck in the system*
14) *LEI report 2.07.10. Ban on enriched cages for layers in the Netherlands. The Hague. www.lei.wur.nl*