SSPE-CT-2004-502315

LAYWEL

Welfare implications of changes in production systems for laying hens

Specific Targeted Research Project (STReP)

Thematic Priority: Integrating and strengthening the ERA, Area 8.1.B.1.4, task 7

LayWel - Periodic Final Activity report

Period covered: from 01/01/2004 to 31/12/2005 Date of preparation: 28/03/2006

Start date of project: 01/01/2004 Duration: 2 years

Project coordinator: Prof.Dr.Ir. H.J. Blokhuis Revision [draft 2]
Animal Sciences Group -
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1. Project execution

Project objectives

The conditions under which laying hens are kept remain a major animal welfare concern. It is one of the most intensive forms of animal production and the number of animals involved is very high. Directive 1999/74/EC setting-down minimum standards for the protection of laying hens allows three different categories of farming systems: unenriched cages, alternative systems and enriched cage. The provisions of the Directive are being progressively implemented since 2002 and have introduced technical changes in the current systems. Since there is only restricted practical experience with production in enriched cages, and since modifications to the current systems have been adopted, knowledge on the welfare implications of the different poultry farming systems needs to be updated.

The LayWel project produced a series of reports on the various welfare aspects of laying hens. Although special emphasis was put on enriched cages and the welfare of laying hens housed in it, alternative housing systems, such as aviaries and free range systems were also investigated. The final report of the layWel project gives a method to estimate the welfare of laying hens in any kind of housing system.

As the LayWel project did focus on the welfare of laying hens, all workpackages (WP) were seen in this perspective and therefore only dealt with aspects influencing bird welfare.

The WPs leading to the final report were:
1. Welfare definitions
2. Housing systems
3. Health
4. Behaviour
5. Physiology and stress indicators
6. Productivity and egg quality
7. Integrated welfare assessment

Contractors involved

Partic. no.	Participant name	Participant short name	Country
1	Institute for Animal Science and Health, ID-Lelystad *	ID-Lelystad	NL
2	Research Institute for Animal Husbandry, PV-Lelystad *	PV-Lelystad	NL
3	ADAS Consulting Ltd. - Gleadthorpe Poultry Research Centre	ADAS	UK
4	Danish Institute of Agricultural Science	DIAS	DK
5	Institut National de la Recherche Agronomique – Poultry Research Unit	INRA	F
6	Swedish University of Agricultural Science	SLU	S
7	University of Bristol	UNIVBRIS	UK
8	Univerität Hohenheim	UHOH	D
9	Universidad de Zaragoza	UNIZAR	E

* both part of the Animal Sciences Group of Wageningen University and Research Center

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2. Work performed

The general objective of the LayWel project was to produce a series of reports on the welfare of laying hens in various systems, with special focus on enriched cages, and to make the information well known, particularly over all member states of the EU and associated countries. The reports not only contain knowledge and state of the art from the countries involved in the project. The LayWel project has been divided into 7 Workpackages (WP), each of them focussing on a specific task in the project. Each WP produced one or more reports dealing with these tasks. The last WP had the task to combine the results of the preceding WPs. The report of this 7th WP of the layWel project is meant to draw some conclusions with regards to welfare of laying hens in various housing systems. It provides the pros and cons of the various housing systems. WP7 also provides a method to estimate the welfare of laying hens in any kind of housing system.

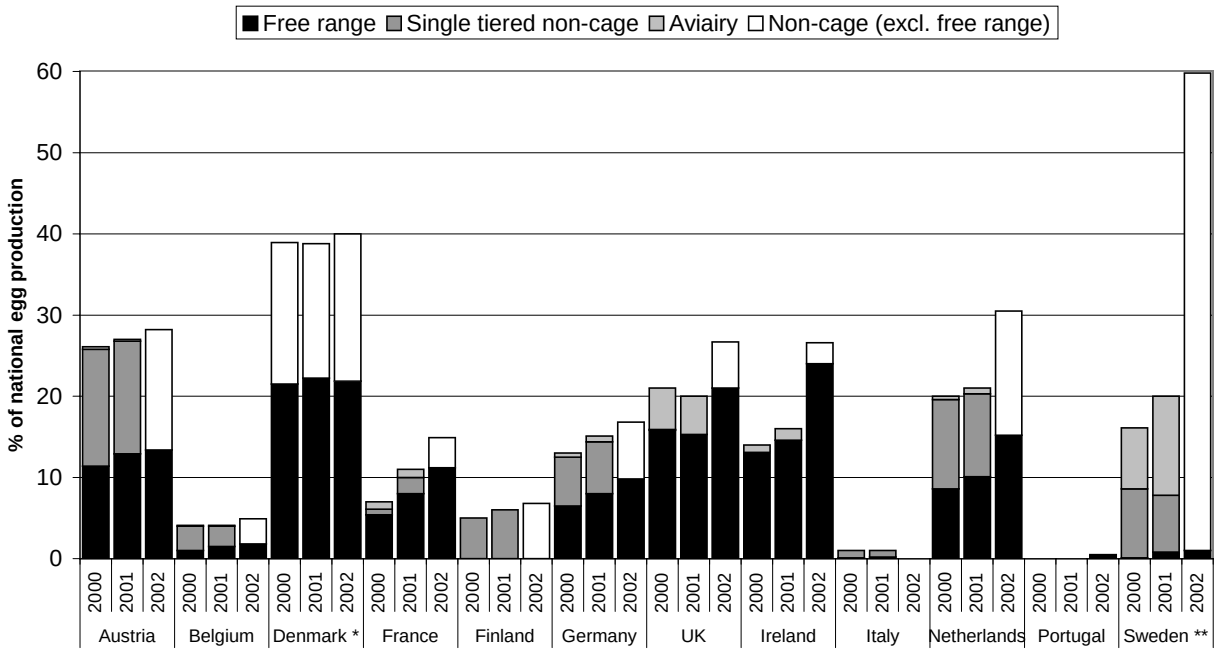
WP1 has focussed on a definition of animal welfare. Although several definitions are published no consensus have been achieved. Also most attempts have been focussed on the perception of welfare in Northern Europe. WP1 has studied the various definitions and criteria or measurements made to relate to welfare. An overview of these and some comments on it were presented in a draft in the first project year. The draft was discussed by all partners and stakeholders. This draft was used by all partners as a basis for the other WPs. After a second round of comments by stakeholders, the draft was modified on some minor points and then finalised.

WP2 has focussed on housing systems for laying hens. Council Directive 74/1999 defines 3 categories. However, to determine the relation between welfare and housing, a more detailed categorisation is needed. WP2 has produced a detailed description of more categories of housing systems. This description is agreed on by the partners and is used as basis for the evaluation of welfare of hens in various systems. In the table the major categories with their acronym and a very brief specification is given. In the second year the draft was updated and finalised.

Major housing categories with acronyms used and some specification

Acronym	Description	Specification
CC	conventional cage	All cage systems that are not furnished
FC	furnished cage	Cages with furnishment as required by EU-Directive 1999/74; no distinction in group size
FCS	small Furnished cage	FC with up to 15 hens/cage
FCM	medium Furnished cage	FC with 15-30 hens/cage
FCL	large Furnished cage	FC with above 30 hens/cage
NC	Non cage systems	all non-cage systems, e.g. barn, aviary, free range

Growth in production of non-cage eggs per country, seen as percentage of the National production (collected in WP2)



* *from free range 60% is organic*
** *2/3 of cage eggs are produced in furnished cages, which are not included in this table*

Besides this task WP 2 has made an overview of the situation in Europe with regards to housing systems used and number of hens housed in them. In the second year an attempt has been made to collect figures from Eastern European countries, although it appeared very difficult to collect reliable data. The data were incorporated in the previously mentioned draft on housing systems, then commented on by stakeholders and then finalised.

The overall objective of WP3 was to generate, process and compile relevant data on the health of laying hens in enriched cages and alternative housing systems. An important part of this task was the co-ordination and documentation of a scoring system for bird health and welfare, including the condition of the integument, to make it possible to compare trials done in different countries. To obtain this scoring system actions started in March 2004 and a scoring system covering 6 body parts for plumage condition (neck, breast, cloaca/vent, back, wings and tail), pecking damage to skin of rear body and comb, and bumble foot lesions at scores of 1 - 4 is described and photographically documented for white as well as for brown genotypes.

The intention was that this system should be easy to use by scorers of different background e.g. scientists, welfare inspectors, administrators, breeders and producer organisations. It should provide a good general picture for the documentation of the status of integument

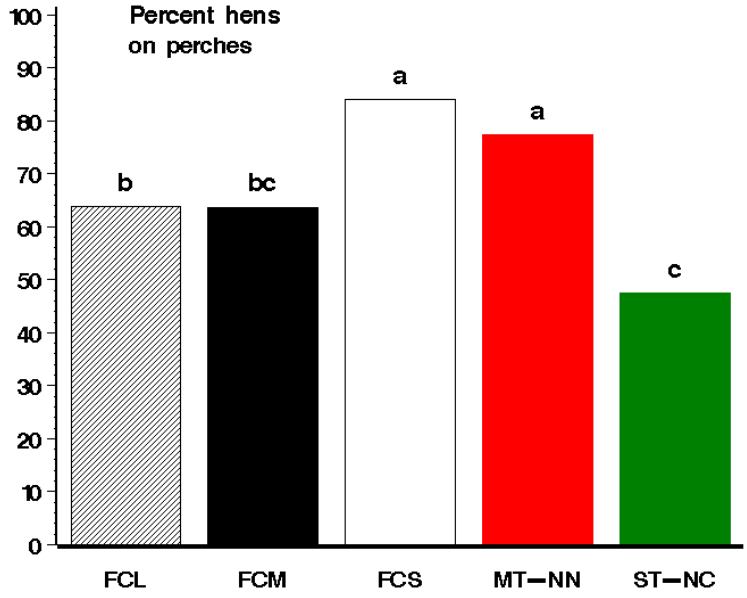
Example of scoring system for integument of hens. This photo indicates scoring scale 3 of back of white hen.

and health of birds in research as well as in commercial production. The system is published on the internet: www.livsmedelssverige.org/hona/scoringsystem
Another task of WP3 was the compilation of data on health traits and mortality from lab studies and commercial farms. This task was combined with similar tasks in WP4, 5 and 6, where data on behaviour, physiology and egg production need to be collected. For this goal a lot of effort is put in the set-up of a good database, that facilitates all partners to contribute data in the same format and that enables statistical analysis. The systematic chosen has been discussed in a meeting in August 2004. This led to several changes and additional datasheets to collect information to enable comparison of data from different sources. In the second project year new data have been entered and some modifications in the design of the database were made. For WP3 data on health traits and mortality were collected. This resulted in a 430 record data base sheet with health data from different housing systems including bird mortality originating from the different partners in the LayWel project. As the statistical analysis of this database was very difficult, many discussions with partners followed, both during meetings and through extensive e-mail contacts. Finally it was decided that there was not one single correct way of analysing the data. The chosen model for statistical analyses therefore represents one of several possible models to be used where a considerable unbalance exists in the recorded data. Bearing this in mind, the treatments considered for analysis of variance were quite broad consisting of PARTNER, SYSTEM (CC, FCL, FCM, FCS and NC), GENOTYPE (BROWN or WHITE) and BEAK TREATMENT (BEAK TRIMMED and non BEAK TRIMMED). For some systems, e.g. the FCLs, there were relatively few data reported and only from 3 partners while the FCSs were far better represented. Several significant effects from the treatments were found as well as some interaction effects. When applicable, comparisons with conclusions drawn in the EFSA report 2005 are made. Among the main results were the lower mortality and better plumage condition in beak trimmed birds than in non beak trimmed, especially in brown genotypes. Birds in FCLs showed higher mortality rates mainly due to pecking than in conventional cages, small- and medium sized furnished cages – the FCS showing the lowest average mortality rate. However, some recent but unpublished British data and data from Germany on more very recent designs of FCLs - not included in the present data base - indicate much lower mortalities than in the present data base. Plumage condition was inferior in non cage systems compared to in FCS in commercial farms with non beak trimmed birds of both genotypes. As regards foot condition the NC systems were inferior to CCs and most often to the FCs. The incidence of keel bone deformities is connected to the use of perches or improper design of other places birds choose to roost on and is thus, mainly present in alternatives to CCs. It is proposed to update the present data base at a later stage.

WP4 was focussing on the behaviour of laying hens. For the first year this has resulted in a literature review with bird preferences, a table with references of literature on feather pecking in various production systems and a report on definition of behavioural indicators for evaluating substrate quality.
A report on the prevalence of feather pecking in various production systems was produced in the second project year. The report considers information only from birds housed in commercial-scale systems (not very small experimental trials). The report was completed with information from the above mentioned database. Feather pecking is still a very predominant welfare problem in commercial flocks in non cage systems with a prevalence of between 40 and 80%. The prevalence of cannibalism is lower but with up to 20% of flocks were affected in one survey and up to 40% in another. Hens kept in any of the four furnished cage models compared did not differ in level of feather pecking or aggressive pecking. It was concluded that the presence of apparently purposeless behaviour or of high levels of aggression or

redirected behaviours such as feather pecking and cannibalism are important indicators that can be use to evaluate a certain housing system with respect to bird welfare.
An other important behavioural aspect is dustbathing, pecking and scratching behaviour. Substrate needs and preferences to perform these behaviours was studied in the first project year and a ranking of the different substrates in terms of importance to perform the behaviour could be made. The value of a particular substrate varied with the behaviour performed in the substrate. There was a strong demand for peat moss for dustbathing. By observation important criteria of the behaviour were defined for assessing substrate quality. These criteria were used to evaluate litter quality in various housing systems in the second project year. As behavioural studies are time consuming and budget was limited two extremes were chosen: furnished cages and single floor non-cage systems. Substrate in barn systems gave more opportunities for laying hens to perform dustbathing and foraging behaviour as compared to the substrate area in furnished cage systems. The low proportion of hens performing foraging behaviour and the absence of complete dustbaths in furnished cage systems indicates that the substrate areas in these systems do not fulfil the needs of the hens, confirming the results of earlier studies in furnished cage systems. Hens in larger group cages (60 birds per cage) were found to perform more (incomplete) dustbathing than hens in 40 bird group cages.
The last activity of WP4 was recording of behaviour in a range of egg production systems as well as investigations of more specific parts of these systems, i.e. area for roosting, for feeding, for exploration and dustbathing, for nesting and so on. The nature and severity of abnormal behaviours and damaging allo-pecking (feather pecking and cannibalism) was monitored. Birds reared on floor had a slightly higher dustbating activity than cage reared birds. Use of nestboxes was different for different genotype of hens and differences in design of the housing system. The perching area of furnished cages was used typically of about 40 to 50% of the hens during the day and of 80 to 90% during the night. The use of perches at night was higher in the smaller compared to medium or larger furnished cages. The use of the dustbathing area was very different for the four models of furnished cages that could be compared from the LayWel data.

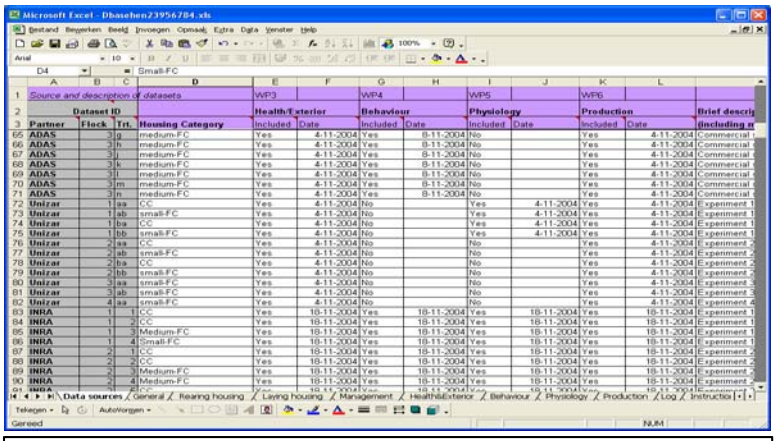
The percentage of hens (ls-means) using the perches at night in furnished cages (FCL = large, FCM = medium and FCS = small group size) and multi tier, non-interg. nests (MT-NN) or single tier (ST-NC) non cage systems. N=114 obs. (Swedish (SLU), Dutch (PV) and Spanish (Unizar) data) (Delivarable 4.6)



For WP5 a check-up list was made of ongoing studies within the laboratory of the LayWel partners with regards to stress and physiology in laying hens. A list of physiological parameters was made and one or more appropriate ones were chosen. Corticosterone in plasma and faeces play an important role in this, but also heterophil-lymphocyte ratio (H/L) is considered as a good stress indicator.
Apart from defining the best physiological indicators, also research was conducted to see if birds in different housing systems have a different physiological response and thus may experience differences in stress. For this data were compiled from 16 independent experiments, provided by five LayWel's partners. As a consequence, the experiments differed first in their scientific objectives but also in numerous other aspects including rearing and housing conditions or densities, as well as the genotypes which entered the study, which made it difficult, if not impossible, to reach firm conclusions. Depending upon the parameter chosen it could be concluded that welfare was improve, comparable or decrease in enriched cages or alternative systems compared to standard cages. Despite these contradictions one can not conclude that physiological indicators are not relevant to assess welfare. Indeed, it illustrates the risk of misinterpretation that can result by taking into account a single or a limited number of welfare indicators of the same category and-or to conclude from a single study or by concluding using only one genotype. Moreover, some original and interesting findings have come out of this work package.
First, it is of major importance to keep in mind before drawing firm conclusions that the responses measured for the different physiological indicators differed depending upon genotypes and/or the period of lay. Therefore, differing levels of responses should not be misinterpreted. Moreover, results originating from different independent studies have shown that there is strong interactions between the physiological responses measured during the laying period and the conditions to which the pullets were submitted to during the rearing period. This observation clearly indicates that this initial period of life is of primary importance for a better adaptation of the hens to their future housing conditions and consequently their welfare. A second major finding is that there is no evident negative effect of the density in floor system or of the cage system (conventional vs. furnished) as such, whereas one specific cage model can be at the origin of different responses. Fourth, consequences of beak trimming can be controversial in term of welfare and care should be taken before banning this possibility to prevent feather pecking and cannibalism occurrence in some strains. Last but not least, in this context the selection against feather pecking is an interesting approach, which have been shown to be successful and such selection programs seems to be positively associated with lower HPA axis reactivity to stress in low feather pecking hens.

WP6 deals with production and egg quality as far as it effects bird welfare. As already mentioned above a lot of effort is put in the set-up of a database to collect data from all partners with regards to results in various housing systems. The design process brought to light the difficulties in comparing data from different studies because variables measured, the time when they are measured and the techniques used turned out to be very study specific. Solutions were found to overcome these difficulties in order to be able to include as much data as possible in the database. Two main data entry rounds (one each year) were held to collect all the data from the eight different partners. The data entry process was managed by ADAS. The final database included eleven different topic worksheets (Data sources, General, Rearing housing, Laying housing, Management, Health/Exterior, Behaviour, Physiology, Production, Log, Acronyms), data from 230 different flocks and 459 lines of data. A data line comprised variables for a certain treatment, so data entered for a flock of birds could consist of several data lines covering the different treatment groups (e.g. different housing systems). Information from WP2 describing different housing systems and housing categories used in

laying hen production were incorporated into the database to be used as descriptors for the different studies. Different partners from the consortium contributed production data from their studies to WP6 (see Table). Most of the data came from replicated scientific studies that have been subjected to statistical analysis and verification.



Example of database sheet

Contribution of the different LayWel partners to the production dataset for WP6

System	PV-Lelystad	ADAS	DIAS	INRA	SLU	UNIVBRIS	UHOH	UNIZAR
Partner	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Conventional cage		X	X	X	X		X	X
Furnished cage	X	X		X	X		X	X
Single tier non-cage system	X	X	X		X	X	X	
Multi tier non-cage system	X			X	X		X	

The final status of data entry for WP6 is:

- ADAS (partner 3) provided production data from two studies on laying hens in small group furnished cages. It was decided not to use data from a third flock because this study had to be aborted prematurely due to severe levels of feather pecking in intact beaked hens. In addition, data from a study on a commercial partner's site with various models of small and medium group furnished cages was entered. In the second project year data from a study on commercial farms covering different systems (conventional cages, single tiered non-cage systems and small, medium and large group furnished cages) was entered.
- PV-Lelystad (partner 2) provided production data from studies on different types of small, medium and large group furnished cages and from single and multi-tiered non-cage systems. The data was entered in the first project year, but expanded in the second project year.
- DIAS (partner 4) provided production data from single-tiered non-cage systems on commercial farms and data from conventional cages.
- INRA (partner 5) provided production data from studies on conventional cages and small and medium group furnished cages as well as multi-tiered non-cage systems.
- SLU (partner 6) provided production data from conventional and small group furnished cages as well as multi-tiered non-cage systems. In the second project year data from small group furnished cages and single- and multi tiered non-cage systems on commercial farms was entered.
- UNIVBRIS (partner 7) provided production data from studies on single-tier non-cage systems.
- UHOH (partner 8) provided production data from studies on furnished cages and from single- and multi-tiered non-cage systems. In the second project year data from a study on conventional and small, medium and large group furnished cages was entered.
- UNIZAR (partner 9) provided production data from studies on conventional and small group furnished cages.

The production parameters overall, show that production is less efficient in non-cage systems (e.g. higher feed conversion ratios). The results indicate however, that the performance of birds in the different types of furnished cages is not worse than that of those in conventional cages. The egg quality parameters such as cracked and dirty eggs show that egg quality in furnished cages is dependent on cage design, but does not need to be a problem with the right cage design. The design of furnished cages has further improved recently and production parameters from these new models should be evaluated to get a more up-to-date picture of production in small, medium and large group furnished cages. This would require a short extension to the data population and use of the LayWel database, which would be well worthwhile.
The LayWel data on production parameters clearly illustrates the high use of the nest box for laying eggs by laying hens and therefore the high risk to welfare of hens in conventional cages when nesting is not possible. As discussed in Workpackage 4, the high use of nest boxes indicates that laying hens place a high value on a discrete nest space. Use of the nest box may therefore be used as an indicator of welfare. If the use of the nest box is low (e.g. due to poor design) or decreases over time, the needs of the hens are not met.
The conclusions of WP6 are that the main production parameters (feed and water parameters and egg production parameters) are not suitable as important indicators of welfare, but they should be monitored continuously and used as an indicator that welfare may be or become impaired. Nest box use can be used as an indicator of welfare as laying hens place a very high value on laying eggs in a secluded area.

WP7 was focussing on the evaluation of welfare in various housing systems. This was done by combining the results of all other WPs. The main work for WP7 therefore was scheduled in the second year of the project. In the first year literature have been reviewed to study possible techniques to evaluate welfare of laying hens. The outcome of the other WPs did not allow a statistical analysis. Therefore the evaluation of welfare in WP7 was done through a presentation of risk factors and advantages an disadvantages of various housing systems. Both the approach and the draft have been discussed with the stakeholders. The final report first considers the approaches to welfare assessment and integration, and then discusses the evidence available to the LayWel project for comparing welfare of laying hens in different systems. The methodology used in this report is then outlined before welfare indices are compared within and between systems. Results are summarised in a colour-coded table that estimates the risks to welfare within and between systems for a range of indices. The advantages and disadvantages of the three main categories of housing system are then discussed. The report is concluded with a list of recommendations that highlights areas for future research and development as well as some of the most important indicators of welfare that should be routinely and frequently monitored on farm.
The conclusions in the report are that, with the exception of conventional cages, all systems have the potential to provide satisfactory welfare for laying hens. However this potential is not always realised in practice. Among the numerous explanations are management, climate, design, different responses by different genotypes and interacting effects. For example there was different use of nestboxes in furnished cages by different genotypes. The design of small furnished cages also had a significant impact on dustbath use.
All cage systems tend to provide a more hygienic environment with low risk of parasitic disease. There is possibly a high risk of poor welfare on a flock basis in all systems with larger group sizes (above approximately 10-15 birds) from damaging pecking and cannibalism. All laying hens also are at high risk from sustaining fractures both during the laying period and at depopulation. There is evidence that both these problems are associated with genetic selection for high productivity. Some existing genotypes (mainly white feathered) show a lower tendency for damaging pecking. Much greater emphasis should be placed on selecting

genotypes with reduced damaging feather pecking tendencies for use in alternative housing systems for laying hens. Recent studies have shown that bone strength can be improved in laying hens by selection over only one or two generations without a great decrease in productivity. For good laying hen welfare it is a priority that action be taken to reduce the current unacceptable level of fractures sustained during the laying period in all systems apart from conventional cages. This is likely to involve a combined approach of selective breeding, plus refinements to design and management including lighting.
Conventional cages do not allow hens to fulfil behaviour priorities, preferences and needs for nesting, perching, foraging and dustbathing in particular. The severe spatial restriction also leads to disuse osteoporosis. We believe these disadvantages outweigh the advantages of reduced parasitism, good hygiene and simpler management. The advantages can be matched by other systems that also enable a much fuller expression of normal behaviour. A reason for this decision is the fact that every individual hen is affected for the duration of the laying period by behavioural restriction. Most other advantages and disadvantages are much less certain and seldom affect all individuals to a similar degree.

Risk to welfare for key indicators in different categories of housing system (simplified table, derived from Workpackage 7.1)
In most cases the orange areas indicate a variable risk

Indicator	Conventional cage	Furnished cage			Non-cage		Outdoor
		small	medium	large	single level	multi level	
Mortality (%)							
Mortality due to feather pecking and or cannibalism							
Red mite							
Bumble foot							
Feather loss							
Use of nest boxes							
Use of perches							
Foraging behaviour							
Dustbathing behaviour							
Air quality							
Water intake							

[Note, some very recent unpublished figures indicate low mortality is achievable in large furnished cages]

red	orange	green

Finally time has been spent on developing an on-farm auditing procedure. Discussions with partners at meetings and on the webtool led to the outcome that the manual should be principally a self-assessment tool. The manual consists of three parts. The first part is a general introduction to the welfare of laying hens. The second part describes various housing systems and the risks to welfare in different housing systems. The third part contains forms, with some guidance, for frequent checks of laying hen welfare. As an appendix some extra background information can be given with for instance local legislation, addresses etc.

3. Reference to the project public website

During the running time of the project there has been realised a co-operation with the Welfare Quality project, which is also funded by FP6 of the EU. The non-public side of the website was vividly used by LayWel-researchers to exchange information and to have discussions on several topics. The address of the public side is:
http://www.welfarequality.net/welfarequality
On this side in short time there will be made a link to a specific LayWel website, where all information collected in the LayWel project will be presented. The address of the LayWel website is not yet known. It is expected to be on the web before the 15th of April 2006.

Annex – Plan for using and disseminating the knowledge

Section 1 - Exploitable knowledge and its Use

Overview table

Exploitable knowledge (description)	**Exploitable product)s) or measure(s)**	**Sector(s)** of application	Timetable for commercial use	Patents or other IPR protection	Owner & Other Partner(s) involved
1. Internationally equal scoring of exteriour of laying hens	*Photographic scoring system*	*1. Commercial poultry farms* *2. Research*	*2006* *2006*	*No protection*	*Partic. 6 (owner)* *Partic. 4 & 9 helped in development*
2. Auditing welfare of laying hens at farm level in any housing system	*Manual for self assessment of welfare of laying hens on farm (English version)*	*1. Commercial poultry farms* *2. Extension services*	*2006*	*No protection*	*Partic. 7 (owner)* *Partic. 9 helped in development*
3. Overview technical results various housing systems in various European countries on commercial and experimental farms	*Database*	*1. Research*	*2010*	*Held confidentially by the partners*	*Partic. 6 (leader)* *Partic. 2 – 9 contributed to the database*

1. Photographic scoring system

A scoring system to quantify feather quality, skin lesions and other health characteristics is important to be able to measure the effect of housing, management and/or treatment on health and welfare of hens. As almost every research institute has developed its own scoring system, the findings in the literature with regards to integument of hens are very hard to compare. This makes it very difficult to compare the various studies and it is almost impossible to draw general conclusions with regards to the effect of various housing systems, management, and/or treatments. The LayWel photographic scoring systems provides a standards, that is easy to use, language independent, applicable in any situation and supported by the major institutes working on welfare of laying hens. This makes this system unique and will give it the potential to be the first world-wide standard.

All LayWel partners already use the system. As they are the leading institutes in this field and as they communicate very frequently about the system, already other institutes have started to use it (e.g. Applied Research - Geel - Belgium). Partner 6 is the leading partner for this result and has also already put the system on the internet. Partner 4 and 9 helped developing the system.

The scoring system will be made more accessible on the LayWel -website, that will be available in short time. As more and more institutes will use the system, research results from various research institutes will be more comparable in the future.

The scoring systems if free of any intellectual property rights and can be used freely by anybody. No further development of the systems is needed.

2. Manual for self assessment of welfare of laying hens on farm (English version)

The manual provides a tool to farmers to monitor the welfare status of their birds in an objective way. It can also be used by extension people. The manual provides tools to measure various welfare aspects and it stimulates farmers to monitor welfare of their birds on a frequent basis. It also indicates ways to improve welfare. By using the manual farmers will be more aware of the welfare of their birds and the effect of their management on it. The tool is practical, but also gives more fundamental information. A similar tool has never been produced. The manual is free of any intellectual property rights and can be used by anybody.
Partner 7 has produced the tool with help of partner 9. The tool is ready to use on commercial farms as defined in the LayWel project as final result. However, two more steps would make it even better and more widely applicable:

1. The manual has not yet been tested on commercial farms. This would actually be a useful and logical step to further develop and improve the manual.
2. As it is now the manual is in English, which makes it less easy to use for non-english speaking countries. Also some addresses to obtain more information on the subject (section 4) are only suitable for the situation in the UK. Translation in other languages and modifying the page with the addresses would make the manual better applicable in other countries.

Although the above mentioned ideas for further development of the manual have been discussed among partners, no further steps have yet been taken to realise this. Therefore the manual will be register as an exploitable result looking for further support. Apart from that the possibilities will be reviewed to see if the manual can be incorporated in the Welfare Quality project.

3. Database

The database comprises results of many studies on housing of laying hens in various European countries. The data are collected both on commercial farms and in experimental units. The database is unique for several reasons: 1. the data origin from studies on all type of housing systems, with special emphasis on furnished cages; 2. the data come from different countries all over Europe; 3. the database contains data on many topics, ranging from production to behaviour.
A problem with a database like this is that the data origin from many different sources. Housing conditions, management, type of hen, type of feed all differ. This makes it extremely difficult to draw sound conclusions. Only people who know the background of the data, whoe know how studies were done and what has happened in the experiment can judge the data right. Therefore the database is only open to partners of the LayWel project, who on their turn will not use the database without consulting the other partners. Each partner remains owner of its own data. In this way misusage and wrong conclusions are prevented.
The value of the database already has shown in the LayWel project, when welfare of laying hens was evaluated. However, although even new and unpublished data were put in the database, still the feeling was that for some systems (especially large furnished cages) data were missing and more data may change the conclusions. As the demand for up-to-date figures remains vivid and new data are produced frequently a way is sought to keep the database updated. This is the reason why the database will be register as an exploitable result looking for further support.

Section 2 – Dissemination of knowledge

Overview table

Planned/actual Dates	Type	Type of audience	Countries addressed	Size of audience	Partner responsible / involved
24.02.05 (1)	*Meeting*	*Stakeholders*	EC	30	All partners
24.05.04 (2)	*Thesis*	*Higher education, research & Industry*	France	40	INRA
08-13.06.04 (3/4)	*Conference*	*Research/Industry*	World	400	INRA
25.08.04 (6)	*Meeting*	*LayWel partners and co-workers*	EC	20	All partners
09.12.04 (6)	*Conference*	*Industry*	France	100	INRA
09.12.04	*Press briefing*	*Journalist*	France	5	INRA
12.04 (7)	*Conference*	*Higher education, research & Industry*	International	?	UHOH
04 (8)	*Article*	*Higher education, research & Industry*	World	?	INRA
04 (9)	*Article*	*Higher education, research & Industry*	Germany	?	UHOH
04 (10)	*Conference*	*Higher education, research & Industry*	Germany	?	UHOH
04.0305 (8)	*Thesis*	*Higher education, research & Industry*	Spain	40	UNIZAR
15-16.03.05 (9)	*Conference*	*Higher education, research (INRA)*	France	150	INRA
30-31.03.05 (10/11)	*Conference*	*Research & Industry*	France	250	INRA
18-20.04.05 (12)	*Workshop*	*Research*	EC	40	ID-Lelystad, UNIVBRIS
23-26.05.05 (13)	*Conference*	*Research and industry*	Europe and overseas	120	PV-Lelystad
15-19.06.05 (14)	*Conference*	*Research and industry*	Europe and overseas	120	All partners
22-24.09.05 (15)	*Conference*	*Research/Industry*	World	200	Most partners
01.09.05 (16)	*Diploma*	*Higher education, Research & Industry*	France		INRA
12.09.05 (17)	*Conference*	*Industry*	France	20	INRA
16.11.05 (18)	*Meeting*	*Stakeholders+ members EC*	EC	50	All partners
08.12.05 (19)	*Conference*	*Industry*	France	150	INRA
05 (20)	*Article*	*Research & Industry*	Sweden	?	SLU
05 (21)	*Article*	*Research & Industry*	Sweden	?	SLU
05 (22)	*Article*	*Higher education, Research & Industry*	World	?	INRA & SLU
05 (23)	*Internet site*	*Higher education, research & Industry*	World	?	SLU
05 (24)	*Conference*	*Higher education, research & Industry*	Germany	?	UHOH
05 (25)	*Conference*	*Higher education, research & Industry*	Germany	?	UHOH
2006 (26)	*Thesis*	*Higher education, research & Industry*	Spain	40	UNIZAR
2006 (27/28)	*Article*	*Higher education, research & Industry*	World	?	INIVBRIS

Planned/actual Dates	Type	Type of audience	Countries addressed	Size of audience	Partner responsible / involved
2006 (29)	*CD-rom*	*Higher education, research & Industry*	World	?	All partners

(1) Reports, oral presentation and discussion of each WP for stakeholders, partners and co-workers of LayWel.

(2) Thesis: Guesdon V. (2004) Etude comparative de poules pondeuses épointées ou non élevées en cage standard ou aménagées : estimation multicritères du bien-être. Thèse U. Rennes I, 220p.

(3) Published paper: Guémené D, Guesdon V, Moe RO, Michel V & Faure JM. (2004) Production and stress parameters in laying hens beak-trimmed or not, housed in standard or furnished cages. *In :* 22nd World's Poultry Congress; Istanbul (TUR); 2004/06/08-13, Proceedings:321(abstract), CDROM:[/1225.pdf] 4p. WPSA, turkish branch, Izmir (TUR).

(4) Published paper: Moe RO, Guémené D, Larsen HJS, Bakken M, Lervik S, Hetland H & Tauson R. (2004) Effect of pre-laying rearing conditions in laying hens housed in standard or furnished cages on various indicators of animal welfare. *In :* 22nd World's Poultry Congress; Istanbul (TUR); 2004/06/08-13, Proceedings:329 (abstract), CDROM: [\1619.pdf] 4p. WPSA, turkish branch, Izmir (TUR).

(5) Oral presentation of each WP for partners and co-workers of LayWel.

(6) Published paper: Guémené D, Couty M, Guesdon V, Moe RO, Lervik S, Michel V & Faure JM. 2004. Bien-être des poules pondeuses en cages conventionnelles ou aménagées : quels sont les enseignements des essais conduits en station expérimentale ? Journée Nationale ITAVI des Professionnels de la pondeuse et de l'œuf de consommation, 9 Décembre 2004, Ploufragan, France. 11p.

(7) Bessei, W. (2004). Entwicklungen und Perspektiven in der Legehennenhaltung. DGfZ-Schriftenreihe - Sachstand und Perspektiven der Legehennenhaltung - Internationale Legehennentagung, 4. Dezember, Leipzig 36: 5-15.

(8) Published paper: Guesdon V, Leterrier C, Constantin P, Guémené D, Couty M & Faure JM. (2004) Humeral quality and adrenal responsiveness in laying hens reared in standard and furnished cages. Animal Research, 53:235-243.

(9) Bessei, W., Prof., Dr., (2004). Bedeutung und Gestaltung von Kaltscharrräumen. Jahrbuch für die Geflügelwirtschaft 107-112.

(10) Bessei, W. (2004). Experiences with modified enriched cages (MEC) for laying hens. Vortrag, Erfahrungen zur Boden, Volieren- und Freilandhaltung, Bonn 2004

(8) Buttow Roll, V. F. (2005). Productivity and animal welfare on commercial laying hens housed in furnished cage systems. PhD-thesis.

(9) Guémené D, Couty M, Guesdon V, Moe RO, Lervik S, Michel V & Faure JM. (2005) Impact sur plusieurs indicateurs de bien-être des systemes « cage » et des pratiques d'élevage chez la poule pondeuse. 1ères Journées d'Animation Scientifique du Département PHASE (INRA), Tours, France, Mars 15-16. p223.

(10) Guémené D, Guesdon V, Moe RO, Michel V & Faure JM. (2005) Paramètres de production et indicateur de bien-être chez des poules pondeuses épointées ou non, élevées en cages standard et aménagées. 6èmes Journées de la Recherche Avicole, St Malo, France, March 30-31 Ed ITAVI, Paris (FRA). Abstract p 29. Full text (CD Roms) p82-86.

(11) Accepted paper: Colson S, Arnould C, Guémené D & Michel V. Bien-être de poules pondeuses logées en cage ou en volière : paramètres physiologiques et comportementaux. 6èmes Journées de la Recherche Avicole, St Malo, France, March 30-31, 2005.

(12) European workshop, entitled 'Should hens be kept outside? Nijmegen, the Netherlands, April 18-20, 2005.

(13) Accepted paper: Fiks, T.G.C.M., 2005. Housing systems for laying hens and their effect on egg quality. XIth European Symposium on the Quality of Eggs and Egg Products, 23-26 May 2005.

(14) 7th European Symposium on Poultry Welfare, Lublin, Poland, 15-19 June, 2005. Name of session: 'Welfare implications of changes in production systems for laying hens' of which the LayWel project will be a major component. The following contributions have been made and are published in the proceedings of the Symposium:

Papers of presentations:

a) Blokhuis, H.J. Welfare implications of changes in production systems for laying hens.

b) Croxall, R.A.; Elson, H.A.; Walker, A.W. Effects of beak trimming on laying hens in furnished cages. Proceedings of the 7th European Symposium on Poultry Welfare, 15-19 June 2005, Lublin, Poland. In: Polish Academy of Sciences Animal Science Papers and Reports Quarterly, V 23, supplement 1. Pp. 71-76.

c) Nicol, C.J., Dixon, G., Green, L.E., Weeks, C.A. and Whay, H.R. (2005) On-farm data collection to assess and improve laying hen welfare. Proceedings of the 7th European Symposium on Poultry Welfare, 15-19 June 2005, Lublin, Poland. In: Polish Academy of Sciences Animal Science Papers and Reports 23, Supplement 1, 17-25. (Invited paper).

d) Tauson, R., Kjaer, J., Maria, L. and Cepero, R. Applied scoring of integument and health in laying hens. Proceedings of the 7:th European symposium on poultry welfare, Lublin, Poland, June 2005. Animal Science Papers and Reports. 23: 153-159.

e) Tauson R. and Holm, K.-E. Mortality, production and use of facilities in furnished cages for layers in commercial egg production in Sweden from 1998-2003. Proceedings of the 7:th European Symposium on Poultry Welfare, Lublin, Poland, June 2005. Animal Science Papers and Reports. 23: 95-102.

Papers of poster presentations:

a) Fiks-van Niekerk, T.G.C.M., Elson, H. A. Categories of housing systems for laying hens. Proceedings of the 7th European Symposium on Poultry Welfare, 15-19 June 2005, Lublin, Poland. In: Polish Academy of Sciences Animal Science Papers and Reports Quarterly, V 23, supplement 1. Pp. 283-284.

[b] Guémené D, Couty M, Guesdon V, Moe RO, Lervik S, Michel V, Colson S, Faure JM, Buil T, Chacon G, Maria G, Cepero R, Wilkins LJ, Brown SN, Zimmerman PH, Nicol CJ. Physiological indicators input in the welfare assessment of various housing systems for laying hens. 7th European Symposium on Poultry Welfare, Lublin (Poland), 15-19 juin 2005 (Poster). Animal Science Papers and Reports 23(1): p269-270.

[c] Van de Weerd H.A, Fiks-van Niekerk, T.G.C.M, Elson, H.A. Overcoming barriers of study-specific methodology to facilitate meta-analysis of laying hen welfare data in the LayWel project. Proceedings of the 7th European Symposium on Poultry Welfare, 15-19 June 2005, Lublin, Poland. In: Polish Academy of Sciences Animal Science Papers and Reports Quarterly, V 23, supplement 1. Pp. 291-295.

The following publication is also related:

[a] Nicol, C.J., Brown, S.N., Glen, E., Pope, S.J., Short, F.J., Warriss, P.D., Zimmerman, P.H., and Wilkins, L.J. (2005) Effects of Stocking Density, Flock Size and Management on The Welfare of Laying Hens in Single-Tier Aviaries. Accepted for publication in British Poultry Science.

[b] Zimmerman, P.H., Brown, S.N., Glen, E., Lindberg, C., Pope, S.J., Short, F.J., Warriss, P.D., Wilkins, L.J. & Nicol, C.J., (2005) The effects of stocking rate and modified management on the welfare of laying hens in Non-Cage System. 7th European Symposium on Poultry Welfare, Lublin (Poland), 15-19 juin 2005. Animal Science Papers and Reports 23(1): p181-188.

(15) 3rd International Workshop on the Assessment of Animal Welfare at Farm and Group Level, 22 - 24 September 2005. University of Veterinary Medicine, Vienna.

(16) Simon, E. (2005) Influence du modèle de cage, de la taille de groupe et du génotype sur des critères zootechniques et comportementaux chez la poule pondeuse élevée en cage aménagée. Mémoire ESA d'Angers. 34p.

(17) Report for National stakeholders of LayWel.

(18) Meeting with stakeholders and members European Commission to discus drafts of final reports.

(19) Guémené D, Couty, M. & Simon, E. (2005) La cage idéale : avec quels aménagements et pour quels génotypes ? Journée Nationale ITAVI des Professionnels de la pondeuse et de l'œuf de consommation, 8 Décembre 2005, Ploufragan, France. 9p

(20) Wall, H. & Tauson, R. 2005a. Uppfödningen har betydelse för värphöns i inredda burar. Fjäderfä 2005 (8): 24-26.

(21) Wall, H. & Tauson, R. 2005b. Produktion, befjädring och stress hos två hybrider i olika inhysningssystem. Fjäderfä 2005 (10): 58-60.

(22) Moe RO, Guémené D, Larsen HJS, Bakken M, Lervik S, Michel V. & Tauson R. Adrenal- and immune responsiveness in laying hens: Interactions between housing system and pre-laying rearing conditions. Submitted for publication to British Poultry Science.

(23) Tauson, R., Kjaer, J., Maria, G.A., Cepero, R. & Holm, K.-E. 2005. Applied scoring of integument and health in laying hens. On internet based homepage address *www.livsmedelssverige.org/hona/scoringsystem*

(24) Bessei, W. and P. Gayer (2005). Alternative Haltungssyteme für Legehennen. Vortrag, LAF-Tagung, Hohenheim, 22.02.05

(25) Bessei, W. and P. Gayer (2005). Neue Ergebnisse zur Kleingruppenhaltung. Vortrag, WPSA Jahrestagung, Papenburg 2005

(26) Buil López-Menchero, T. (2006). Development of a System to assess an audit on laying hens welfare. Thesis, approx. defence date: 2006.

(27) Weeks, C.A. and Nicol, C.J. (submitted/2006) Preferences of laying hens. World's Poultry Science Journal.

(28) C.A Weeks, C.J. Nicol, S.M. Haslam and R.C.Whay (in press/2006) Self-evaluation of laying hen welfare on farm. British Poultry Abstracts, 2 (1)

(29) CD-rom with all reports and results of LayWel, being:

- Bessei, W. (D1.2). Report with consensual version of welfare definition and welfare indicators
- Fiks, T. & R.A. van Emous (D2.2) Description of housing systems for Laying hens
- Tauson, R., Kjaer, J., Maria, G.A., Cepero, R, and Holm, K-E. (D3.1) Applied scoring of integument and health in laying hens.
- R. Tauson, K. Elwinger, Karl-Erik Holm & H. Wall (D3.2-3.3) Analyses of a data base for health parameters in different housing systems
- Weeks, C.A. and Nicol, C.J., (D4.2) Prevalence of feather pecking in various production systems.
- de Jong, I.C., Wolthuis-Fillerup, M. and van Reenen, K., (D4.3) Substrate preferences in laying hens.
- de Jong, I.C., Kjaer, J.B. and Wolthuis-Fillerup, M., (D4.3) Substrate preferences in chickens selected for and against feather pecking behaviour.
- de Jong, I.C., and Wolthuis-Fillerup, M., (D4.4) Definition of behavioural indicators to evaluate substrate quality in different housing systems for laying hens.
- de Jong, I.C., Wolthuis-Fillerup, M., Reuvekamp, B. and Fiks, T., (D4.5) Evaluation of substrate quality in two different housing systems (barn systems and furnished cages) for laying hens with respect to dustbathing and foraging behaviour.
- Kjaer, J. B., (D4.6) Behavioural function of production systems for laying hens.
- Kjaer, J.B., Fiks, T., de Jong, I.C., Nicol, C.J., van Reenen, K., Reuvekamp, B., Weeks, C.A., and Wolthuis-Fillerup, M., (D4.7) Behaviour.
- Guémené, D. (D5.4) Physiology and stress indicators.
- Van de Weerd, H.E. & H.A. Elson (D6.2) Report on Production and Egg quality.
- C.A Weeks, C.J. Nicol (D7.1) Overall strengths and weaknesses of each defined housing system for laying hens, and detailing the overall welfare impact of each housing system.
- C.A Weeks, C.J. Nicol, S.M. Haslam and R.C.Whay (D7.2) Manual that can be used to audit the welfare of laying hens at a farm level in whatever housing system they are held.

Section 3 - Publishable results

1. Photographic scoring system

Result description

The LayWel photographic scoring system covering 6 body parts for plumage condition (neck, breast, cloaca/vent, back, wings and tail), pecking damage to skin of rear body and comb, and bumble foot lesions at scores of 1 - 4 is described and photographically documented for white as well as for brown genotypes. The LayWel photographic scoring system provides a standard, that is easy to use, language independent, applicable in any situation and supported by the major institutes working on welfare of laying hens. This makes this system unique and will give it the potential to be the first world-wide standard.

Possible market applications

A scoring system to quantify feather quality, skin lesions and other health characteristics is important to be able to measure the effect of housing, management and/or treatment on health and welfare of hens. As almost every research institute has developed its own scoring system, the findings in the literature with regards to integument of hens are very hard to compare. This makes it very difficult to compare the various studies and it is almost impossible to draw general conclusions with regards to the effect of various housing systems, management, and/or treatments.

The LayWel photographic scoring system is easy to use by scorers of different background e.g. scientists, welfare inspectors, administrators, breeders and producer organisations. It provides a good general picture for the documentation of the status of integument and health of birds in research as well as in commercial production.

Stage of development

The system is ready for use

Collaboration sought or offered

Both scientists and other parties dealing with scoring of the exterior of hens are invited to use the system to enable a better comparison between measurements in various countries and situations.

Collaboration details

No specific collaborations is sought.

Intellectual Property Rights IPR)

The system is free of IPR. When used, reference to the origin of the system is expected.

Contact details

The system is published on the internet: www.livsmedelssverige.org/hona/scoringsystem

The scoring system will be made more accessible on the LayWel -website, that will be available in short time.

For questions or more details contact can be made with:

Prof.Dr. R. (Ragnar) Tauson
Swedish University of Agricultural Science
Dept. of Animal Nutrition and Management

Avian Division
Kungsängens Research Centre
753 23 Uppsala Sweden

2. Manual for self assessment of welfare of laying hens on farm (English version)

Result description

Manual that can be used to audit the welfare of laying hens at a farm level in whatever housing system they are held. The manual provides a tool to farmers to monitor the welfare status of their birds in an objective way. It can also be used by extension people. The manual provides tools to measure various welfare aspects and it stimulates farmers to monitor welfare of their birds on a frequent basis. It also indicates ways to improve welfare.

Possible market applications

The manual can be used by farmers, but also by extension people. By using the manual farmers will be more aware of the welfare of their birds and the effect of their management on it. The tool is practical, but also gives more fundamental information.

Stage of development

The tool is ready to use on commercial farms as defined in the LayWel project as final result. However, two more steps would make it even better and more widely applicable:

3. The manual has not yet been tested on commercial farms. This would actually be a useful and logical step to further develop and improve the manual.
4. As it is now the manual is in English, which makes it less easy to use for non-english speaking countries. Also some addresses to obtain more information on the subject (section 4) are only suitable for the situation in the UK. Translation in other languages and modifying the page with the addresses would make the manual better applicable in other countries.

Collaboration sought or offered

Although the above mentioned ideas for further development of the manual have been discussed among partners, no further steps have yet been taken to realise this. Therefore the manual will be register as an exploitable result looking for further support. Apart from that the possibilities will be reviewed to see if the manual can be incorporated in the Welfare Quality project.

Collaboration details

Collaboration for further development will first focus on funding of further work. Also funding to translate is needed. Apart from the LayWel partners new partners are welcome, although this would mainly apply to partners from a country with a language that is not yet represented in the LayWel consortium.

Intellectual property rights

The manual is free of any intellectual property rights and can be used by anybody.

Contact details

Min contact partner is:
Dr. C (Claire) Weeks
University of Bristol
Department of Clinical Veterinary Science
Division of Farm Animal Science
Langford House

Langford, Bristol BS40 5DU
United Kingdom

3. Database

Result description

The final database includes eleven different topic worksheets (Data sources, General, Rearing housing, Laying housing, Management, Health/Exterior, Behaviour, Physiology, Production, Log, Acronyms), data from 230 different flocks and 459 lines of data. A data line comprises variables for a certain treatment, so data entered for a flock of birds can consist of several data lines covering the different treatment groups (e.g. different housing systems). Information from the LayWel project describing different housing systems and housing categories used in laying hen production were incorporated into the database to be used as descriptors for the different studies. Different partners from the consortium contributed production data from their studies to the database. Most of the data came from replicated scientific studies that have been subjected to statistical analysis and verification. The database comprises results of many studies on housing of laying hens in various European countries, that are collected both on commercial farms and in experimental units.

Possible market applications

Although there are no direct market applications, further development of the database is important to market parties. With the database researchers can identify better what the weak and strong aspects of various housing systems are. Problems can be detected and comparing results from various institutes may also lead to solutions. So the information obtained by using the database can be of major importance to the industry in developing and improving their systems. For decision makers the database provide a reliable source of information that enables them to make decisions based on facts.

Stage of development

The value of the database already has shown in the LayWel project, when welfare of laying hens was evaluated. However, although even new and unpublished data were put in the database, still the feeling was that for some systems (especially large furnished cages) data were missing and more data may change the conclusions. As the demand for up-to-date figures remains vivid and new data are produced frequently a way is sought to keep the database updated. This is the reason why the database will be register as an exploitable result looking for further support.

Collaboration sought or offered

Collaboration in further development of the database first will be sought in funding to enable the existing consortium to continue with the work. Expanding the consortium is possible as more research stations are collecting similar data.

Collaboration details

The first need to develop the database is funding to enable the LayWel partners to work on the database. New partners can be useful if they can contribute with data from their research. This however is only possible with proper funding.

Intellectual property rights

A problem with a database like this is that the data origin from many different sources. Housing conditions, management, type of hen, type of feed all differ. This makes it extremely difficult to draw sound conclusions. Only people who know the background of the data, whoe know how studies were done and what has happened in the experiment can judge the data

right. Therefore the database is only open to partners of the LayWel project, who on their turn will not use the database without consulting the other partners. Each partner remains owner of its own data. In this way misusage and wrong conclusions are prevented.

Contact details

Although the data remain property of the partners who provided the data, the co-ordination of the database was done by:

Dr.Ir. H. (Heleen) van de Weerd
ADAS
Meden Vale
Mansfield, Nottinghamshire NG20 9PF
United Kingdom