Organic poultry farming

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Abstract

The development in organic livestock production can be attributed to an increased consumer interest in organic products while, at the same time, farmers are interested in converting to organic production methods – often stimulated by governmental support or subsidies. It is important that the organic production systems can fulfil the expectations of each of these stakeholders if the organic livestock production is to increase further. This is in particular important if the organic poultry production should move from the present niche-production to a real player in the food marked, like in the case of beef and milk.

It can be argued that the limited organic poultry production is related to the fact that it is far more difficult for the farmers to change the existing production systems for poultry compared to production systems for cattle and other ruminants in a way that gives a harmonious balance between the different aims of organic farming. In the existing systems for layers with flock sizes of 3,000 hens and where the hens have access to an outdoor area, the egg production and the feed conversion can be close to production results in conventional production. However, often a considerable mortality can be seen in organic egg production in part due to cannibalism and often also very high nutrient loads are observed in parts of the outdoor area. These conditions are important drawbacks in existing systems.

In order to improve the situation there is a need to look at the genotype of hens, to consider new management procedures, and – not at least – to consider new systems where the poultry to a higher degree are integrated in the land use. Promising results with integration of chickens, ducks and geese into an orchard production is found. Also preliminary results of housing systems for small flocks of layers are presented.

Introduction

There has been a tremendous growth in numbers of organic farms in Europe over the last 20 years – from approximately 8,000 in 1985 to more than 142,000 in 2001 and with a correspondingly increase in organic managed land (Figure 1; Willer & Richter, 2003). Nevertheless, at present only 3% of the European agricultural land is managed organically and the market share of organically produced products is no more than one to two percent although with large differences among countries.

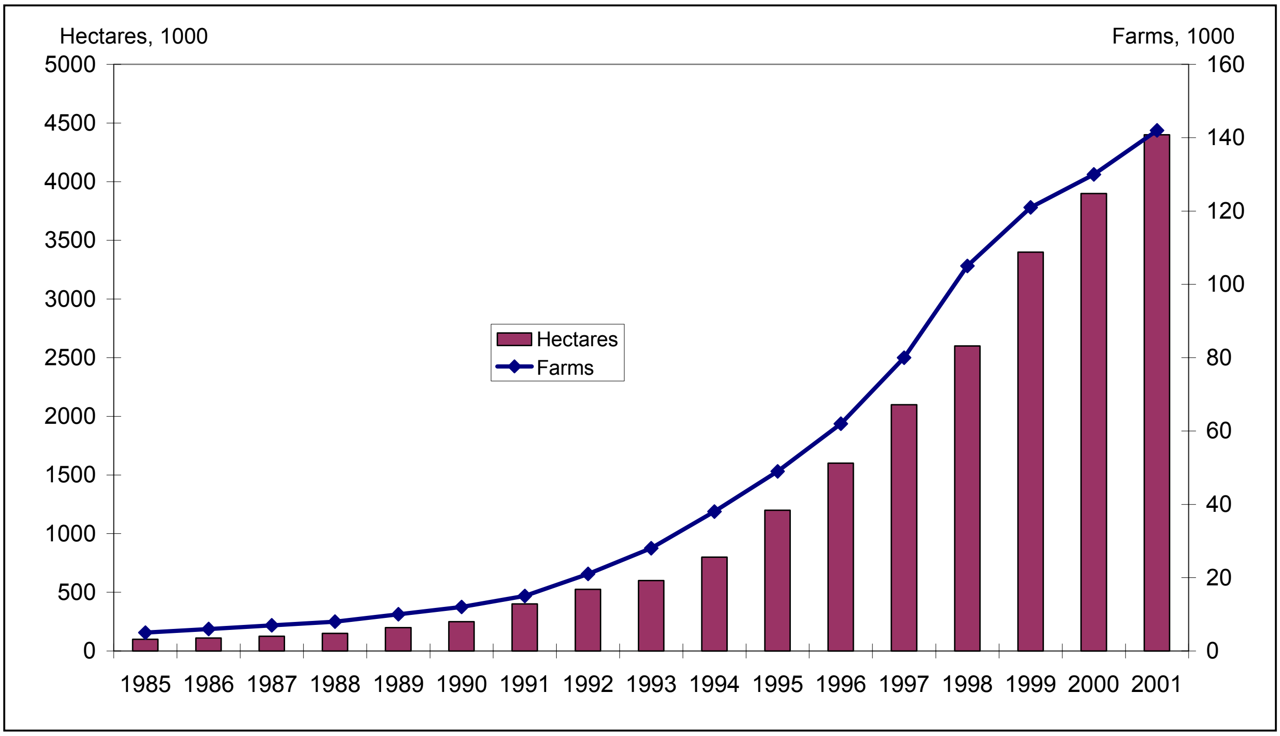

Figure 1: Development of land under organic management and of organic farms in the European Union from 1985 to 2001 (Source: Willer & Richter, 2003).

Eggs were on the top five organic products in 4 out of 18 European countries in late nineties (Michelsen et al., 1999). In Denmark number of organic layers increased from less than 20,000 in 1990 to 500,000 in 1999. After 1999, the number of organic layers has stabilized resulting in an egg production of approximately 6,300 t/per year. This corresponds to 12% of the total Danish egg production. At the consumer level it is estimated that the proportion of organic egg consumption is 17-18% of total egg-consumption.

Livestock often plays an important role – besides supporting income for the farmers – in obtaining some of the principle aims in organic farming i.e. diversified production and supporting biological cycles within the farming system. However, some main conflicts may appear in how and to what degree the different aims can be obtained. In relation to livestock, conflicts may appear in the most appropriate keeping practice related to consideration of the basic aspects of their innate behaviour on one hand, the risk of pollution from the production on the other and, in addition, the aim of producing in sufficient quantities. These possible conflicts are reflected in the compromises set in national or EU regulations on organic farming. In the long term, it seems important that production systems are developed so that different sorts of livestock production can contribute directly to a steadily increasing fulfilling of the organic ideals on a national scale or at farm level. This point of view has until now scarcely been elaborated.

Andresen (2000) puts words to the idea saying that the view on livestock should be changed from considering them as being passive (receivers) to active parts of the sustainable development of the production systems. More focus should be put on the (various) capabilities of the animals and less on the "requirements" of the animals. The challenge is then to give conditions so that the livestock can optimize the value of their various capabilities rather than to control the animal in the environment. The emphasis on animal performance then shifts from mere feed conversion to functional efficiency in the farming system. This leads to new parameters for evaluation.

Several examples of interaction/synergism can be given. First of all, there is the well-known and accepted role of ruminants when converting fibrous feed to high value nutrients (for example fibrous feed from the grassland), which is grown i.e. for the purpose of maintaining soil fertility and limiting growth of weeds in organic crop rotations (Younie & Hermansen, 2000), and e.g. the sheep-olive integration (Trujillo, 2000).

However, also poultry may exert important synergism in supporting a harmonic development of a farm. A main issue in this context may be to find ways for a better integration of poultry production in the land use in general. It might be anticipated that a further overall increase in organic production in many countries will depend on to what extent such a development actually can take place for poultry and monogastrics. The aim of this paper is to highlight some of the prospects and constraints for such an integration based on Danish experience so far.

Regulation and typical production systems

The implementation of the organic ideals in the EU-regulation includes for poultry production, among others, a maximum flock size for layers on 3,000 and for chickens of 4,800. These flock sizes are well below flock sizes normally seen in conventional free-range poultry production, but still much higher than what can be considered as “natural” flock sizes. The birds shall be kept under free-range conditions i.e. having access to a hen yard corresponding to at least 4 m^2 per laying hen. Also, coccidiostats cannot be included in the feed, no beak trimming is allowed and ages at slaughter for broilers should be at least 81 days to counteract a too high growth rate.

The organic egg production, where the hens are kept in relatively large flocks and have access to an outdoor area, can be carried out quite efficiently in terms of egg production and feed conversion compared to conventional egg production in cages, although the feed consumption often is considerable higher (Kristensen, 1998).

In Table 1 the average productivity and price relations during the last 8 years are given for the herds participating in the voluntary recording scheme organized by the Danish Poultry Council. It appears, that the laying percent is lower in organic production compared to the cages system when calculated per hen inserted. This is partly due to a considerable higher mortality in organic systems. During the period it has been possible to obtain more than the double selling price of the eggs which in turn result in an improved egg/feed price relation.

Table 1: Average productivity and prices in the period 1995-2002, Per hen housed at insertion (Danish Poultry Council, 2003)

	White layers in cages (21-76 weeks)	Organic brown layers (21-68 weeks)
Feed intake, grams per day	112	131
Laying pct.	86.8	73.5
Mortality pct.	4.9	14.8
FCR[1)], kg of feed per kg of eggs	2.07	2.81
Egg prices, DKK per kg	5.89	14.21
Price relation, egg/feed	4.17	6.39

[1)] Feed conversion rate

The production results given above are valid, at least when the high yielding commercial lines or crosses are used. However, the high yielding hen has, through many generations, been selected for high performance on the base of her production capacity measured in individual cages. Thus, little attention has been paid to her genetically based ability to behave well in a larger flock of hens. The result of such breeding policy is a high yielding hen, but it seems that she has lost some of her ability to have social relations with many hens in large flocks (Sørensen & Kjær, 2000). In Table 2 is given the results from an experiment in which different genotypes kept under organic conditions were compared. There is obviously a considerable difference in laying capacity among the four lines with ISA-Brown having the highest laying capacity. Regarding mortality, the lines were ranked in almost the opposite way. In particular the cannibalism of the ISA-Brown was to such a level that it was above 10% in six of the eight replicates within a period of 6 month from 18 to 43 weeks of age. Hardly, any cannibalism was seen for the other breeds. The higher mortality of New Hampshire was partly due to a mild outbreak of coccidioses, which mainly hit the New Hampshire.

Table 2: Results of laying traits and mortality for various breeds. (After Sørensen & Kjær, 2000).

Breeds/Genotypes	New Hampshire (NH)	White Leghorn (WL)	WL x NH	ISA-Brown	P-value for difference
Rate of lay, %	63.2^{c}	72.4^{b}	69.2^{b}	84.6^{a}	0.0001
Nos. of eggs 18-43 weeks	88.8^{c}	103.4^{b}	105.5b^{c}	127.2^{a}	0.0001
Age at first egg, weeks	22.2^{a}	22.9^{a}	21.4^{b}	19.8^{c}	0.0001
Egg weight, g	54.7^{c}	58.3^{ab}	57.0^{b}	59.3^{a}	0.0001
Total mortality, %	13.8^{a}	6.7^{b}	3.9^{b}	19.9^{a}	0.0199
Mortality- cannibalism, % 18-43 weeks	1.4^{b}	0.0^{b}	1.1^{b}	16.0^{c}	0.0001

a-c Estimates in a row with no common superscript differs significantly ($P<0.05$)

Also in commercial free-range systems with large flocks, including organic farming systems, too many cases have been observed in which hens have started to perform feather pecking that ended with an unacceptable high rate of cannibalism. As indicated above and confirmed in more detailed investigations the total mortality is often recorded to at least 20% during a year (Kristensen, 1998). This figure covers not only cannibalism, but also deaths caused by predators and by an inappropriate behaviour of the birds, which sometimes suffocate because they tend to bunch together. This high mortality rate is a major problem, particularly from an animal welfare aspect and in the eyes of the consumers. There is a need to catch up improved lines that are still high yielding, but with less risk of performing unacceptable feather pecking. Small selection experiments have shown that these behavioural traits have a genetic basis (Boelling et al., 2003) and ought to be incorporated into a breeding goal for lines used in organic farming in order to make production in the farming system economically sound and acceptable from a welfare point of view.

Management of traditional hens yard

It has been shown that there was a negative correlation between the birds' use of the outdoor area and the feather pecking as well as between "the quality" of the outdoor area and the feather pecking

(Bestman & Wagenaar, 2003). This is an important issue since often only a small part of the birds actually use the outdoor area, if no specific measures are taken.

Hirt et al. (2000) showed that the percentage of the hens of a flock in the free range area decreases with increasing flock size and that the use of the outdoor area often was restricted to the area most close to the house. Besides, affecting feather pecking this also has implications for the health of the birds and the environmental impact. The load of manure just outside the house increases risks for leaching of N and also risks for the spread of infection diseases among the birds. So, there seems to be a need to develop new strategies for the bird's use of the outdoor area.

Several management options have been investigated. Inclusions of cockerels in the flocks have been demonstrated to result in less frequent aggressive behaviour among females (Odén et al., 1999), as well as an increased use of the outdoor area and a reduced feather pecking (Bestman & Wagenaar, 2003). Our own observation supports the idea that the establishment of shelters in the yard, whether natural like trees and bushes, or artificially actually do stimulate the hens to use the outdoor area better. At some producers drainage systems are established just outside the house to avoid small pools of water, which is contaminated with pathogens. In particular, sea shells seem to be a good solution. Nevertheless it seems difficult to manage large flocks in a traditional hen yard without having a considerable risk for poor welfare or too high environmental load.

Beyond hen yards

Probably more radical different concepts for the organic poultry production need to be considered. Elements to be considered here can be:

- The ability of the poultry to find a significant part of their feed in the outdoor area
- The impact of the poultry on the ground and/or the vegetation
- The impact of the poultry on the presence of pests of importance for crops

As regard layers and broilers, the high nutritional requirements necessary to maintain a high production level seem to be a major constraint. It has been estimated that relatively high yielding layers can consume 1/3 of the feed and N-requirement through forage, worms and insects (Hughes & Dun, 1983). However, for the producer it seems very risky to rely on such a strategy taken our present knowledge in consideration and being aware of the fact that nutritional stress in high yielding genotypes may have several implications for welfare and production. There is clearly a need to expand our knowledge in this area including knowledge on relevant crops or roots to be grown to support such a strategy.

Although doubtful from a nutritional point of view, it is clear that even layers and broilers do have an impact on the ground vegetation in the outdoor area. In relatively small scale organic egg productions (flocks of 1,000 hens), this has been taken advantage of in combined egg - and orchard production. The hens remove the weeds and grass and thereby diminish the need for mechanical weeding in orchards.

More important in such combined production systems is probably the impact of the poultry in fighting pests (insects) in orchards. In organic production in Denmark, nearly no pesticides are allowed. The need for alternative pest control is therefore large. Apple sawfly *(Hoplocampa testusinea)* and pear midge *(Contarinia pyrivora)* cause big crop losses in apples and pears, respectively. Both insects infest fruitlets and cause these to drop prematurely after which the pests pupate in the topsoil.

Pedersen et al. (2002) investigated under experimental conditions the influence of releasing broilers in the orchard to minimize the population of these insects. Preliminary results (Figure 2) showed that a profound reduced catch of sawflies were found on sticy traps in chicken runs. The number of sawflies caught was reduced by 50-75 %. It is unknown whether this pattern is caused by a direct effect of broilers predating the pupae or hatching sawflies, or if sawflies prefer to be in the chicken free areas.

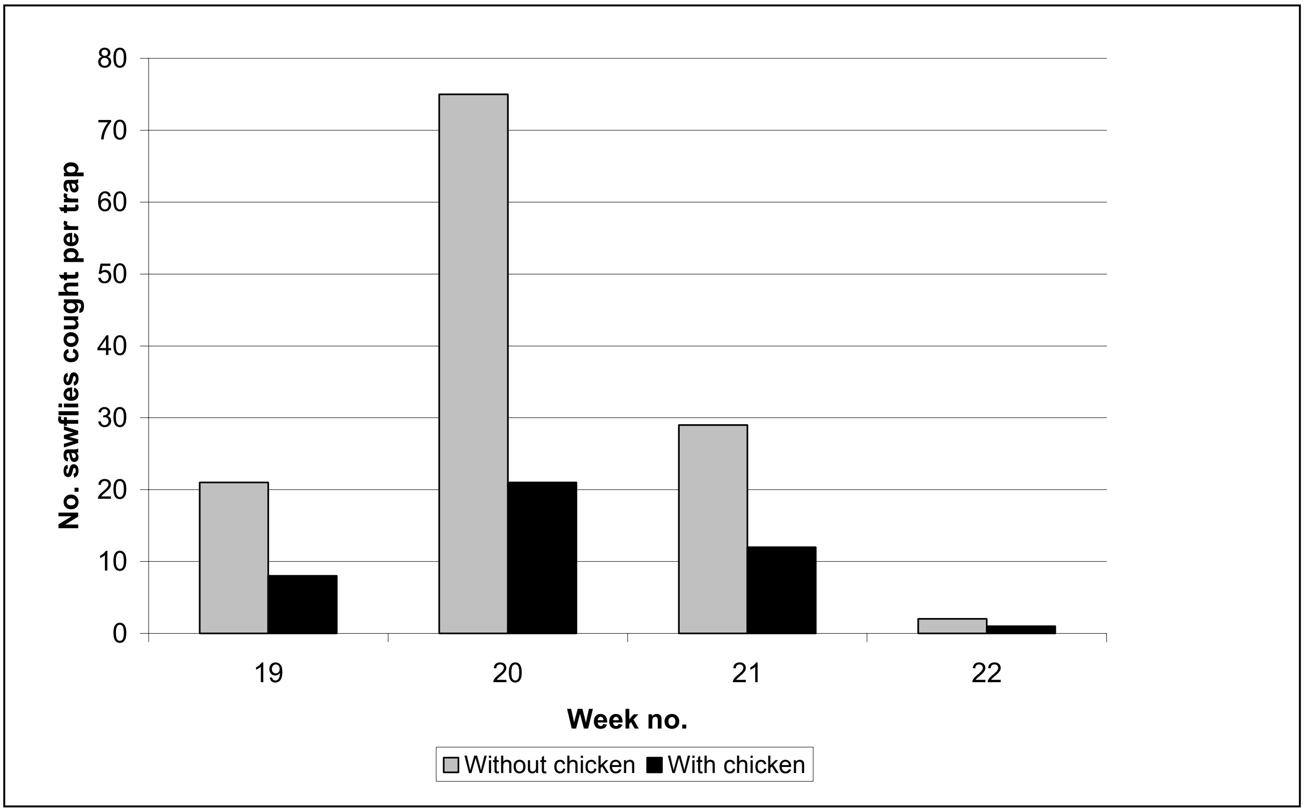

Figure 2: Catch of apple saw flies in an apple orchard with or without foraging chickens (Pedersen et al, 2002).

The reduced catch of apple sawflies, however, had no significant effect on the yield or the fruit quality. The total numbers of flower clusters and thereby the potential fruit crops are, however, not known. As regard pear midge, no effect on infected fruitlets were observed. Nevertheless, the results indicate that an effect can be obtained and may be improved by taken more detailed knowledge of hens/broilers behaviour and the biology of the pests into account.

In the investigation, two types of broilers were used – a specialised hybrid (I 657) and a pure breed (Labress). The daily gain was 29 and 24 g, respectively, and for the hybrid close to the recommended limit of 30 g for organic production. Overall, the welfare and the health of the broilers seemed to be excellent. Welfare assessment of 80 birds showed no problems with the plumage condition and foot health, and no broilers had skin lesions.

Also, Clark & Gage (1996) evaluated the effect of free range chickens and geese on insect pests and weed in a nonchemical apple orchard with intercropped potatoes. It was found that some insect pests were less abundant on apple trees when chickens were present. However, chickens did not affect weed abundance and crop productivity. The authors suggest that a higher chicken density and the use of lures to draw, in this case, the Japanese beetle within range of the chickens could be used to control this pest without pesticides. The authors also suggest another option, which includes the use of movable floorless chicken cages to remove or reduce apple drops on the orchard floor.

The geese, however, were effective weeders, resulted in increased potato plant yield. In addition, the apple fruit damage was reduced, possibly because of removal of the vegetation. It is concluded from the study that domestic geese can be managed as biological weed control agents, though on-farm evaluations are needed to address the social and economic aspects of weeder geese use.

As part of a participatory research programme, we are making observations in an orchard system, where several types of poultry are used in a synergistic manner. The obtained growth rate, feed in-take and nutrient excretion are shown in Table 3. We can estimate an N-excretion (supplementary feed – carcass growth) on 1.7g/chicken/day in average for the growing period of 100 days. From a pests fighting's point of view, a high stocking density could be relevant. The present Danish regulations give a maximum of 1,250 chickens to be reared on a hectare. This yields an N-supply of approx, 200 kg/N/ha over a period of 100 days, which is more than optimal for many orchard crops. So, this aspect needs to be taken into account.

Table 3: Production results of poultry from a combined production of poultry and fruit (2 year season).

	Broilers (I 657)	Broilers (LaBresse)	Ducks	Geese
(n)	(1,580)	(500)	(3,600)	(1,800)
Age at slaughter (days)	100	130	100	150
Mortality (%)	6	3	9	9
Final weight (kg)	2.5	2.8	4.2	6.5
Aver. daily gain (g)	25	22	42	44
Feed consumption (kg/kg LW gain)	3.9	4.5	6.7	4.1*
Aver. N-surplus/bird/day (g)	1.8	1.6	5.2	1.4
Aver. P-surplus/bird/day (g)	0.5	0.4	1.3	0.4

* Only supplementary feed; geese consume large amounts of green fodder for which reason consumption of grain and concentrates vary depending on the quality and amount of available green fodder.

We found especially that the combination of chickens and geese seems promising. The well-known ability of the geese to weed and graze is taking advantage of. In the majority of the growth period, the geese are almost entirely foraging. In this period, only a small amount of net-nutrient deposition on the ground takes place. In other periods, defined by the expected time of the life-cycle where the harmful insects are present at the ground, the chickens are used in the orchard. By using this combination, no major overloading with nutrients takes place.

At slaughter all flocks of birds were examined for salmonella infection/contamination by samples taken from the cloaca. Samples were taken from 40 – 70 birds from each flock according to flock size. No types of salmonella were found. However one flock of chicken and one flock of geese were examined for campylobacter and in both cases the samples were positive. This is in agreement with the expected from birds reared under free-range conditions.

There is a need for a more comprehensive understanding of possible synergistic between the birds and “a crop” taken into account a wider range of crops.

Hens in climate tents

To avoid the problems with the more traditional systems we have decided to study a very different system (Forkman et al 2004). Instead of developing systems for 3,000 birds or more, we have concentrated our studies on flocks of 150-300 animals. To be able to get any economy we have had to develop a system that is different from the relatively conventional one used by most organic egg-producers of today. We are doing this by using a tent (that is relatively cheap to construct) with an artificial “tree” inside. The floor of the tent is covered with sea shells and on top of that straw; the surface area is 45m^2. There are nest boxes placed outside the tent. The tent is always open to the exterior, in this case a fruit orchard. In our study we have two tents, each standing in a fenced area of approximately 1,000 m^2 as part of an orchard. Food and water were provided close to the tent (Figure 3 and 4).

Figure 3: The tent system at the edge of the orchard with the nest boxes placed outside the tent

Figure 4: The chickens quickly found out how to use the sitting rings

A number of studies and observations have now been done on flocks in this system. The main results presented here will however be on two flocks, each consisting of a mix of Hellevad (a cross between White Leghorn and New Hampshire developed especially for use in organic farming) and New Hampshire. The flock sizes were approximately 85 hens, including 10 roosters. The hens were put into the system when 8 weeks old (middle of June), they were not beak trimmed, nor were their feather clipped. For the first two weeks they were kept locked into the tents to facilitate recognition of the surroundings and use of the perches in the tents.

From late October until early December the birds were observed on a daily basis. During the hours of light approximately 35% of the birds were inside or sitting on top of the tent. Approximately 25% of the birds were in the area furthest away from the tent.

The amount of leaves on the trees in the orchard was positively correlated with the number of hens in that part of the field whereas the height of the coverage did not make any difference.

The egg production varied over the year with a mean of approximately 75% egg laying during the entire autumn and the beginning of the winter. This dropped sharply during a cold spell in the middle of December, going as low as 20%, but – surprisingly – increased fairly rapidly again during late winter, reaching around 70% at the end of January.

The birds were plumage scored according to the Tauson scale at slaughter (49 weeks old). The average plumage score was 19.8 out of 20 possible. The main welfare concern in the present system is without doubt the fact that the birds do not have access to a heated area. The hens had on average 12.5% of their comb frost bitten, while the roosters had 12.9%. The winter 2002/03 was very extreme for Danish conditions. However, before the system can finally be recommended for production this is a problem that has to be addressed. Also – despite the fact that the hens made good use of the total outdoor area – very high nutrient loads were observed just outside the tent and under some trees where the hens preferred to stay overnight. This also needs to be addressed.

In conclusion, the present system seems to offer a viable alternative to more conventional housing for egg producers that are content to hold small flocks of chickens. Some more work on specific aspects is needed, however, with the most serious being protecting the birds against excessive cold.

Conclusion

The most common systems for poultry used in intensive managed organic production have some important drawbacks in relation to environmental impacts (risk of N leaching and ammonia volatilisation), animal welfare, high mortality in poultry and workload and management. There is a need for a radical development of the systems. There is a need to search for systems where the outdoor/free range systems (for the sake of the livestock) are constructed and managed in a way whereby the livestock at the same time exert a positive influence on other parts of the farming systems. Major elements to be considered are the ability of poultry to forage and hereby fulfil their nutritional needs, and to contribute to diminishing of pests in orchards. These elements need to be further explored as a basis for future system development.

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