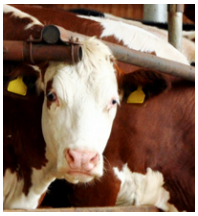
European farmers' experiences with precision livestock farming systems



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Implications

In the public debate about modern animal production methods, the voice of the farmer is rarely heard. Little is known about the daily work and economic pressure the single farmer is exposed to and what he thinks and feels about the increasingly complex production systems with demanding new control and monitoring technologies such as PLF. In a limited survey based on 21 farm visits (nine pig, five broiler, and seven dairy farms) in 10 EU countries, the knowledge of farmers on options and opportunities of precision livestock farming (**PLF**) technologies in modern animal production systems was investigated. The farmers were asked by personal free-format interviews face to face on their farms. Most pig and poultry farms were visited in 2014, just after the installation of the PLF technology in the farms and 2016 again after 2 yr of experience. The dairy farms could be visited only once in 2016. All farmers who get sufficient support from the providers developed a positive to very positive attitude to the real-time monitoring PLF systems. This applies for pig, broiler, and cow farms. Broiler farmers were more open to PLF than pig farmers. All farmers emphasized with few exceptions that the personal contact to the animals cannot be replaced by video cameras, but the PLF systems can be of great help in daily life. They enable the farmer to recognize problems significantly earlier than with conventional methods. These techniques are not only helpful and animal friendly, they may also assist to bridge the presently existing gap between producers and consumers by transparency of production. Drawbacks are the relative high prices for PLF equipment, sometimes poor maintenance service by the delivering companies, and the lack of broader experience with the systems in practice. Although one farmer responded after 2 yr of experience with his PLF system that he would not miss it anymore and that he understands his animals much better since he uses PLF monitoring, there is an urgent need for more and wider experiences. It is recommended to further test and develop PLF technologies in demonstration farms under practical conditions. It seems that PLF technologies can play an important role in the development of a future-oriented, sustainable, animal-friendly, and efficient livestock production with healthy animals.

Background and Introduction

With the advent of modern livestock production systems since the 1970s, the numbers of animals per farm increased dramatically, and worldwide livestock production has grown by a factor of four. The production of pig and poultry meat has doubled in the last 30 yr following the demand of a fast-growing world population for food of animal origin (FAO, 2006). The output of the world meat market for cattle, pig, and poultry rose from about 60 million tons in 1961 to about 280 million tons 2010 (FAO, 2006). Chicken meat production worldwide has reached in 2012 clearly more than 100 million tons (FAO, 2014). For 2030, a total meat production of poultry, pork, and cattle of about 350 million tons is expected (FAO, 2006).

This enormous increase was only possible by significant breeding progress and the development of specialized farms with modern, intensive, and very often non-grazing production systems where the animals are kept in confined houses at high stocking rates. These systems make best use of the animals' selected genetic qualities that enable them, under appropriate housing, feeding, hygiene, management, and veterinary control, to reach high growth rates and high feed efficiencies in the shortest possible time. As an example, the efficiency of egg production of laying hens rose from 160 eggs in year 1960 to more than 300 eggs in 2011. Today, about 360 million red meat animals are slaughtered in the European Union (**EU**) per year along with several billions of chicken. Worldwide, about 60 billion animals are slaughtered for food per year. The number of laying hens in one district of Germany rose between 1960 and 1980 by a factor of nearly 12 from a couple of hundred thousand to 12 million while the number of laying hen farms (with more than 3,000 hens) dropped to a couple of hundred (Klon and Windhorst, 2001; Windhorst, 2006). While the number of animals per farm increased, the number of farms decreased and the number of people making their living as farmers dropped to about 2% in Germany. The 38.5 million laying hens are kept in Germany today on 1,355 farms only (Destatis, 2014).

At the same time, the prices of farm animal products stagnated or decreased. From statistical figures, it is known that the relative expenditure of consumers in Germany of their income for food dropped from 57% in 1900 to 14% in 2010 (Statista, 2012). For the first time in human history, Europeans do not need to worry about sufficient food supply (Hartung, 2013). This is not the case in all parts of the world. World population rose by 30% since 1990 and is estimated to reach 9.6 billion people who have to be fed in 2050. It is expected that then 70% of the world population will live in urban areas, which is up from 40% in 1990 and about 50% today (Mottet, unpublished). Not least

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because of this separation between society and livestock production, concerns about animal welfare are rising, and an increasing number of people in the developed societies are asking for more and better animal protection laws.

As a consequence, modern livestock farming today is under various pressures. There are not only economic pressures, but also the expectations and demands of the society (citizens) and the consumer, which can be summarized as follows:

1. Food security. (900 mio in the food gap. FAO, 2014. How to feed a growing urban population of 9.6 billion people in 2050?).
2. Producer's income and cost-efficient production. Economic viability of the farm.
3. Food safety and quality. Safe and healthy food for consumers.
4. Affordable food for all consumers. Low food prices.
5. Protection of environment, workforce, and residents. Occupational health of farm workers.
6. Animal health and welfare. Farm animal production should be ethical, social, and sustainable.

The society discusses the role of the farmers in animal welfare, animal health, environmental impact of the production, safety, and quality of food and affordable prices. People complain about the intensive farming systems with larger herds or flocks kept indoors, which are monitored continuously by modern surveillance technologies controlling feed amounts consumed, daily weight gain, and indoor climate as well as movement and behavior of the animals to recognize early signs of disease and/or poor welfare.

However, little is known about the daily work and economic pressure the single farmer is exposed to and what he thinks and feels about the increasingly complex production systems with demanding new control and monitoring technologies also known as precision livestock farming (**PLF**). Are these techniques helpful, animal friendly, affordable, and profitable and can they assist to bridge the presently existing gap between the restraints of the producers and the requirements of the society? The voice of the farmer is not heard much in this debate.

This report will try to contribute to a better understanding of the situation of pig, broiler, and dairy farmers in several EU countries. The report summarizes the experience and opinion of 21 farmers/farm managers in 10 EU member countries on PLF technology installed on their farms. The farmers were asked by personal free-format interviews face to face on their farms.

Objectives of the Study

The interviews and farm visits should give an insight in advantages and problems of PLF in practice and should be used to inform strategy development for market entry of PLF technology. In spite of the limited number of nine pigs, five broiler, and seven dairy farms, the answers can be helpful to identify chances, gaps, and deficiencies of PLF.

The objectives of the face-to-face interviews were to learn from the farmers in their living and working environment their attitude and opinion on PLF technology installed in their farms, particularly in regard to

- usefulness for better health and welfare of animals,
- manageability of the techniques,
- technical reliability,
- handling of outcome data,
- trustfulness,
- consumer confidence,
- economic benefits, and
- proposals for improvements.

Materials and Methods

Two rounds of farm visits were performed. The first round was done in spring and early summer 2014 just after the PLF systems were installed in the farms. The aim was to find out what the farmers know about PLF and what their attitude is. The second round was performed 2 yr later in 2016 to learn which approach the farmers developed during these 2 yr of PLF.

In the first half of 2014, in total 13 livestock producers (eight pig and five broiler farms) were visited and questioned in face-to-face interviews about their farming situation as well as their knowledge and expectations in regard to PLF technologies. The questionnaire comprised 16 core questions and another 11 questions related to their farm or personal situation (not referred to here).

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Most Frequent Questions Asked in 2014 and 2016

1. How familiar are you with the term PLF? (2014 and 2016)
2. Why did you decide on this technology?
3. What are the positives associated with this technology?
4. What are the negatives, risks, and uncertainties associated with PLF technology?
5. Do you expect to have more time for social life?
6. What market conditions impact on your livestock production the most?
7. In your experience, where do you see most advantages for your animals using PLF?
8. What is stressing you most—time pressure or your financial situation?
9. How would you rank your farm production?
10. Is animal welfare relevant for you and why?
11. Can PLF technologies improve consumer acceptance/satisfaction of current livestock practices?
12. Can PLF replace the farmer in the barn?
13. How do you see the future of animal production in Europe?
14. What would you like to improve on your farm in the future?
15. Would you employ a paid service to run your PLF system?

Table 1. Participating pig and broiler farms in six European countries and type of technology installed.

Countries, years		Animal species	PLF equipment
2014	2016		
NL	NL	pigs	sound, eYeNamic
NL	NL	pigs	sound, eYeNamic
UK (N-Ireland)		pigs	sound, eYeNamic)
	UK (England)	pigs	sound monitor
HUN	HUN	pigs	sound, eYeNamic, PLFagritec, weight, dust, NH3
FRANCE (Brest)	FRANCE (Brest)	pigs	sound, eYeNamic
ITALY	ITALY	pigs	sound, eYeNamic
SPAIN	SPAIN	pigs	sound, eYeNamic, PLFagritec, weight, dust, NH3
SPAIN	SPAIN	pigs	sound, eYeNamic, PLFagritec, weight, dust, NH3
NL	NL	broiler	sound, eYeNamic
UK (England)	UK (England)	broiler	sound, eYeNamic, (no access to animals for hygienic reasons)
UK (England)	UK (England)	broiler	sound, eYeNamic, RVC dust, NH3
ITALY	ITALY	broiler	sound, eYeNamic
SPAIN	SPAIN	broiler	sound, eYeNamic. (2014 no broilers in the barn, farmer was sick.)

Sound = sound monitoring (Sound Talks), eYeNamic = observation cameras (Fancom, NL), PLFagritec = company providing technology for measuring animal weight, airborne dust and ammonia (NH3).

The answers of the farmers were noted. Some farmers answered questions at length while some gave much shorter answers. That changed from question to question and farmer to farmer. It was important to let the farmers speak so as to be able to learn from their opinions and to build trust between interviewers and interviewees. Some farmers declared themselves unable to answer single questions. That was accepted and noted. The questions were asked in a formalized (but more or less free and easy) way to create a friendly atmosphere. Additional comments of the interviewees were taken up and noted. Longer discussions on certain points were summarized and concentrated to the core answer. The interviews were performed after visits to the animal houses and seeing and talking about the animals, the production system, and the PLF technology installed. In one broiler farm, access to the animal houses was not possible because of hygienic reasons, and in one farm, there were no animals at the time of visit in 2014 because the farmer had fallen seriously ill.

In spring and early summer 2016, the same farmers were interviewed again, as far as possible. Some changes took place. The pig farm in Northern Ireland opted out for personal reasons. In England, a pig farm was added. Table 1 summarizes countries, visit years 2014 and 2016, animal species, and the PLF equipment installed in the respective farm. The second round of interviews was performed by the same interviewer using the same questionnaire. It should reveal the attitude and understanding of the farmers after using the technological features for about 2 yr and to find out if the technologies have lived up to their expectations. In total, nine pig, five broiler, and seven dairy farms in six European (EU) countries were visited. Three companies and one university from four different countries delivered PLF technology.

In the seven dairy cow farms, the same technology (CowView, GEA) was installed. It detects the movement of the cow in the barn by aid of a sensor sealed in a capsule fixed to a collar around the neck of each cow. The movement and resting pattern (frequency and duration) of the individual cow gives an indication when the cow comes in heat and is ready for insemination. A longer resting period can give an indication that the cow does not want to walk much, possibly because of painful lameness. The signals from the sensor are transmitted to a receiver under the ceiling of the barn and appear in the PC where the individual cow is identified along with her position in the barn. Immediately or during next milking time, the cow can be inspected for indicators of heat or lameness. The cow farms could be visited only once because the CowView system was installed in the farms in the course of the second half of 2015 only. Three farms were situated in Germany, two in the Netherlands, and one each in Sweden and Denmark. The size of the farms ranged from 118 to 650 milking cows.

Results

The results are given in the form of short summaries of the responses of the pig and poultry farmers to the most relevant questions. The dairy farmers were in general happy with the CowView system, except for the relatively high price.

Answers from all eight pig farms

How familiar are you with the term PLF? In 2014, only one pig farmer said that he is very familiar with the term "PLF." Pig farmers were not sure or did not know what PLF means. In 2016, all pig farmers felt familiar or somewhat familiar with the term. Broiler farmers were much

Some characteristics of the eight visited pig farms

- Places for fattening pigs ranged between 1,100 and 4,000. Some farms also kept sows for their own piglet production.
- Five farms kept the fattening pigs on a fully slatted floor and three on a half-slatted floor.
- Seven buildings were ventilated by negative pressure systems, one with under-floor ventilation. One farm had natural ventilation. One farm was equipped with an exhaust air purification system (bio-scrubber).
- Growth rates ranged between 600 and 940 g/d.
- The end weight of the pigs ranged from 102 kg/animal to 170 kg (for Parma ham production).
- Feed conversion ranged between 2.1 kg of feed to 1 kg body weight and 3.0 to 1.
- Losses of fatteners were reported between 1 and 2%. One farm reported losses during fattening of 8 to 9%.
- Visits of veterinarians were organized between 2-wk routine and on demand.
- Respiratory disorders and leg problems dominated beside some typical infectious diseases like porcine reproductive and respiratory syndrome virus.
- Medicaments were applied mostly by animal caretakers after veterinary prescription. More medication was used in flat-deck units than in fatteners.
- Veterinary costs varied considerably between "not known" and 5% of production costs.
- The answers were given by farmers/owners themselves. Only on one farm was the farm manager was available.

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Some characteristics of the five visited broiler farms

- The smallest farm had 30,000 broiler places and the largest 600,000 in different houses and at several sites. The usual number of broilers per barn was between 30,000 and 40,000.
- Three farms kept the animals on wood shavings, one on wood chips plus some coconut fiber, and one on chopped straw combined with floor heating.
- All barns were equipped with a forced ventilation systems.
- Growth rates were reported approximately 60 g/d depending on the target weight of the animals.
- Feed conversion ranged between 1.55 kg of feed to 1 kg of body weight for about a 30-d fattening period and 1.75 to 1 for 48 d.
- Dead losses were reported between 2 and 4%.
- The veterinarian visits the farms for vaccination and on demand. The large farm has a regular 2-wk veterinary service.
- Diarrhea is the most frequent disease symptom, followed by leg problems, pododermatitis, and respiratory affections.
- Medicaments like antibiotics are used in one farm once out of seven cycles while other farms need to treat five flocks out of seven.
- Veterinary treatment costs including medication and vaccination were given from €0.02 to €0.04 per broiler.
- The interviews were performed on two farms with the owner and on three farms with the farm manager.

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more familiar with the term PLF than pig farmers. Obviously, automation in broiler farms is more advanced than in pig production. Cow farmers were quite familiar with the CowView system and the term PLF.

Why did you decide on this technology? The decision to install PLF technology was not always in the first instance actively taken by the farmer. It was a decision because of the opportunity of the project and the free installation of the instruments. Pig farmers decided on PLF because they were looking for new opportunities to improve their production. These farmers were interested in modern technology, and they were asked to take part and the equipment was delivered and installed for free. Broiler farmers decided because of interest in new monitoring technology and "forward thinking." Cow farmers wanted to improve their reproduction efficiency and lameness detection.

What are the positives associated with this technology? Pig farmers expect from PLF better growth, health, welfare, and production and a better monitoring of their animals. But there are also concerns and uncertainties. They are not sure about the benefits of PLF as long as it is not demonstrated. Broiler farmers clearly expect better health and production by monitoring. They hope that PLF can improve feed conversion, animal surveillance, and animal health and can help to reduce use of antibiotics. One cow farmer reported that CowView helps him to recognize two to

Some characteristics of the seven visited dairy farms

- The smallest farm had 118 milking cows and the largest 700.
- On all farms, the cows were kept in cubicle houses.
- All barns had natural ventilation with the addition forced ventilation for hot situations.
- Milk production ranged between 30 and 33kg/cow and lactation period.
- Replacement rate was between 20 and 35%.
- Veterinary visits range from daily routine to on-call service.
- Mastitis, claw diseases (lameness), and fertility problems are the most frequently reported diseases.
- All interviewees were farm owners.

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three cows more per week which are in heat than without. And he can select, investigate, and treat lame cows much earlier.

What are the negatives, risks, and uncertainties associated with PLF technology? Pig farmers expect high costs for equipment and maintenance, too complicated an operation, and slow maintenance service. Some see risk of less contact with animals. Broiler farmers are also concerned about possible high costs. They see monitoring as an advantage without disturbing the birds by physical presence. Some of the cow farmers complained about sensors not properly working or damaged. These technical problems seem to be solved.

Do you expect to have more time for social life when applying PLF? Saving time by PLF for private life is not first priority. All farmers hope for more stability in production.

What market conditions impact your livestock production the most? The most important cost factor in pig and broiler production is the feed price, which can reach 60 to 70% of the production costs, depending on the level of integration of the farm in a larger company or consortium. The second cost factor is labor followed by veterinary and medicine costs and eventually energy. Feed is a considerable cost factor also in dairies.

In your experience, where do you see most advantages for your animals using PLF? Farmers hope for less routine work, less untargeted visits to the animal house, better monitoring of growth and behavior, and higher animal health and productivity.

Farmers hope that PLF can substitute "the eye of the farmer" but should not replace it. Broiler farmers do not see any negatives in PLF except possible high costs.

What is stressing you most—time pressure or your financial situation? Pig farmers wish to have a better uniformity of growth, good management of large groups of pigs, a better feed control, and better health.

Comments and suggestions from pig farmers regarding PLF

- Most farmers were interested in new PLF sensors for feed consumption and growth rate and for better indoor climate control.
- All farmers wish to have all information from all sensors in an integrated form that is easy to read.
- Farmers are not yet sure whether PLF can increase the profitability of their production. They need experience with PLF.
- Most farmers expect that the value of PLF for the farming industry is high.
- Farmers want to know more about uniformity of growth, feed and water consumption, and daily gain.
- The main risks are seen in high prices for the equipment and maintenance, difficulties to handle the complex technology, and loss of contact with the animals.
- The most stressing factor is when animals are sick. A considerable stress factor is to find good staff.
- All farmers are concerned about the welfare of their animals, and they support all measures to improve the well-being of their animals; however, animal welfare must be based on a sustainable economic basis of the farm.
- Farmers expect that farms with livestock will grow bigger. The future of livestock production is seen as critical in some countries because of societal pressures. But all are looking more or less optimistically into the future.
- Cost efficiency of PLF technology cannot be assessed because equipment was installed free of charge by project money. Cost of PLF systems should not be more than €10 per pig place.
- Most farmers doubt that PLF can raise acceptance of animal production in the public opinion. Maybe better transparency is possible.

Comments and suggestions from all five broiler farms regarding PLF

- Broiler farmers were much more familiar with the term PLF than pig farmers.
- They decided on it because of interest in new technology and "forward thinking."
- Broiler farmers clearly expect better health and production.
- Similar to pig production, feed price is the highest cost factor followed by labor costs, veterinary service, and energy.
- Broiler farmers do not see any negatives in PLF, except possible high costs.
- Farmer's observation of the animals is of high importance, and PLF can assist.
- All farmers prefer integrated data display and management.
- Most farmers believe that PLF can increase their profitability.
- They see a high value for the broiler industry when the systems are working satisfactorily.

- They hope that PLF can monitor better feed and water consumption, animal weight, climate and health.
- PLF is not associated with risks when properly applied.
- Farmers feel most stressed by time pressure, finance, and summer heat when broilers are not growing well.
- Farmers see animal welfare positively. Birds come first. However, too high demands can kill productivity.
- Farmers see a bright future for broiler farming. Farms will grow larger and produce more efficiently.
- Cost efficiency of PLF has to be demonstrated in practice.
- Consumers' acceptability of PLF can be raised by quality assurance and traceability. Some people cannot be persuaded.
- Broiler farmers wish to have more quality chicks, lower stocking densities, and less use of drugs. They hope for new technologies.

General Conclusion

This limited survey shows the great potential of PLF technology in the livestock sector on medium as well as on larger farms. It will be crucial for the future of PLF to demonstrate the benefits in practice for animal health, welfare, meat quality, consumer safety and satisfaction, environment, and economics for the farmer. Prices for equipment and maintenance will play an important role if farmers are prepared to invest. Demonstration farms that run under normal commercial conditions should be established or existing farms supported to use PLF technologies to generate more knowledge and trust in the systems. Some responses of farmers after 2 yr of experience with their PLF system were encouraging and should lead the way forward: "Since I use PLF, I understand my animals much better" or "I will never work without PLF in future—it reassures me that the animals are healthy and the production is running well."

All tested PLF technologies can monitor automated and real-time conditions of the animals or the environment. These date enable farmers to manage health and welfare of their livestock on actual data. Precision livestock farming technology cannot automatically recognize the causing agent or condition of a disease or an abnormal behavior. The systems can be, however, a very valuable help for immediate action to prevent disease or suffering of the animals or a decline in production.

Discussion and Conclusions

1. The most important cost factor in pig and broiler production is the feed price, which can reach 60 to 70% of the production costs, depending on the level of integration of the farm in a larger company or consortium. The second cost factor is labor followed by veterinary and medicine costs and eventually energy.

   Conclusion: Technology and advice on how to save feed, labor, energy, and veterinary are welcome. Progress in breeding and feed efficiency/conversion has to be discussed in regard to animal health and welfare.

2. The decision to install PLF technology was not always in the first instance actively taken by the farmer. It was a decision because of the opportunity of the project. The decision to go with the PLF project was because of interest in new technology and in new opportunities to improve the health of the animals as well as production.

   Conclusion: The interviewed farmers are open to test new options and challenges in combination with technical offers of the industry to improve the living conditions of their animals and the production.

3. Farmers are cautious to buy new PLF technology as long as they are not convinced of the benefits. In the project, most farmers got the instrumentation for free or little cost. In the future, they want to see if any investment pays out.

   Conclusion: It is important to demonstrate usefulness of PLF in practice or a subsequent demonstration project.

4. Farmers are prepared to go for new equipment when they have a realistic idea of the improvements that can be realized.

   Conclusion: Farmers are open for change but need objective help (qualified services!) to be able to run new systems.

5. Only a few farmers were familiar with the term PLF at the beginning of the project. All farmers who worked actively with the system declared that they were very familiar with PLF now. Those who just let the instruments run did not improve much.

   Conclusion: Precision livestock farming has to be explained and demonstrated in practice in an objective way.

6. Farmers who had experience with PLF technologies before had a more positive attitude and higher motivation to use and understand it.

   Conclusion: More demonstration shows benefits for monitoring health, welfare, and production and may also save labor hours/costs.

7. Before farmers are prepared to buy PLF technology, they want to know the real prices for equipment and maintenance and the benefits in practice.

   Conclusion: Communication of prices and benefits can be best done by successful farmer colleagues and demonstration farms.

8. Most of the interviewed farmers were very much in favor of integrated surveillance and monitoring systems for growth rate, feed conversion, feed and water consumption, climate control, and health monitoring.

   Conclusion: These are important hints for the industry to produce such systems.

9. Negative associations with PLF were high prices, too complicated an operation, and slow maintenance service.

   Conclusion: The PLF industry must address these critics carefully and truthfully.

10. Nearly all farmers said that it is very important to see the animals directly and not only by video. They are concerned about not paying sufficient attention to the animals and losing contact with them.

    Conclusion: The PLF industry must make clear that PLF is a valuable help. Advice should be given that the time saved by PLF should be invested in better animal care.

[continued next page]

11. Farmers were not happy about how they handle the prevention of respiratory diseases. They asked for help to prevent disease and consequently use of antibiotics.

    Conclusion: It seems that there is a need for more technical and managerial offerings to improve the housing environment and air quality and avoid stress of the animals. Heat stress remains a permanent problem in pig and poultry production. Industry should provide better and efficient ventilation systems and heat management.

12. The attitude of the farmers to animal welfare was always positive. The farmers see welfare and health as important factors of their production, which determines very much productivity and income. However, they made it clear that welfare measures without regard to economics are unrealistic.

    Conclusion: Precision livestock farming can help to improve health and welfare and provide more transparency for the consumer.

13. Asked for their opinion on the future of animal farming in Europe, the opinions varied. They all hoped for further farming but expect increasingly difficult conditions caused by welfare NGOs and environmental concerns in the society. In some countries, these concerns were lower than in others countries.

    Conclusion: Precision livestock farming should make clear that it can provide important input in future livestock production by improving health and welfare and safe production and can deliver transparent data of all phases of the growing cycles of the animals.

14. All visited farms called their financial situation "sound" or normal.

    Conclusion: The participating farmers are probably a selected sample above the average.

15. All questioned farmers saw PLF positively. However, the promised positive effects on health, welfare, working environment, and the safety of products must pay the price for the investments and maintenance. One strong disadvantage was that not all instruments were working properly. When farmers have to pay for a system, it must work permanently with little or clearly defined maintenance intervals.

    Conclusion: Industry should offer only PLF systems that are properly working with low maintenance needs.

16. A disadvantage in the project was that only very few farmers understood the installed PLF systems including the PC technology. They were unable to repair or adjust any detail of the system. Even worse, most had no access to the figures or said "data are all with the company." They did not see the results as their own figures.

    Conclusion: Farmers must be enabled to identify themselves with the technology and their own data. They must be able to interpret their data.

17. In this investigation, all farmers understood that it was more a scientific research project and all sides have to learn and improve the systems. But some systems delivered completely unrealistic figures. These instruments are not only useless, they damage also the trust in PLF systems.

    Conclusion: It is important that the industry delivers fully functional and durable systems.

18. It was also interesting to observe that all farmers see at least one or more options for improvements in their production, referred to as better feed and water supply, health, and well-being of the animals. However, farmers are afraid that the market does not pay their investments back. There was the feeling of being left alone with new technology and a lot of legal regulations.

    Conclusion: Precision livestock farming could be one way to look together—industry, farmers, research institutions, universities, and administration—for sustainable solutions!

19. Last but not least: We have to keep in mind that only a very small number of farmers were interviewed who represent a selection of interested and advanced farmers. They all volunteered for the project. They probably do not belong to the average farmers in their country, and the answers cannot be generalized without great care.

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