

EU-PLF

Deliverable 4.1

List of socio-economic measures related to selected key indicators on farm

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Smart Farming for Europe

Value creation through **P**recision **L**ivestock **F**arming



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Management Summary

This deliverable of the EU-PLF project summarises the initial list of socio and economic indicators that was set up by experts, the result of a workshop in the Dutch-Flanders area where the production chains are not integrated, interviews in the Catalan region where there are integrated chains and a European questionnaire on PLF aspects.

The following lessons are learned for the blueprint:

- Economic indicators are a combination of technical production results and cost and benefit relations. Definitions and price mechanisms differ per sector and region.
- Social indicators can be directly connected to PLF products and services and it seems that there are limited sector and regional effects.
- To calculate the effect of PLF products and services it is needed to have a preliminary choice of how to measure and calculate/prove the added value. Especially on which level it will have influence. On animal, group, farm or chain level.
- In general PLF products are not well known and used, and also 'normal' and existing management systems and automatic systems are seen as PLF products.
- Promotion activities and awareness for PLF added value might be needed instead of criticism to the present production methods in livestock farming.
- It is most of the times very complex to connect observations to the real cause of problems and most of the time knowledge is still inappropriate. PLF applications also are faced with this difficulty.
- To prevent 'scandals' it is necessary to improve the production process and to be able to handle the dynamics of the production system and context. PLF can play a role in this. If scandals happen they have a very high impact on social life and economic performance.
- It seems in a lot of discussions that the expectation is that PLF products have a high sensitivity and specificity. This might give problems in the social context since measuring system, models and decision support systems all deal with errors (of different kinds) and uncertainty. This phenomenon needs a special place in the communication on PLF products and services.
- Main drivers in the social and economic area are: communication, transparency, timeliness, dynamics and take care of certainty/risk.
- The business models of the integrated production chain companies in the section feed production – farm – slaughterhouse/cutting room were astonishingly similar. All three companies which occupy very different places in the "ecosystem" use a volume model, i.e. they try to produce a standard product in large quantities with limited margins. Market differentiation is mainly done on price and less on product quality or product parameters. The companies use three types of farms: own, integrated and independent. Control of production quality is difficult due to different ways of data capture and analysis; the companies have to employ own personnel to guarantee equal accounting of factors. An electronic exchange of data would help to streamline this process.
- The openness that the companies and attendants of the workshop displayed when interviewed was very good and seems to give trust in the image of PLF.
- In the questionnaire animal health is the most important factor, followed by food safety, environment and animal welfare. More than two thirds of the respondents chose for the answers related to these topics 'a guarantee for the future' or 'important for the preservation of the sector'. Society and market orientated thinking scored some lower and control of energy use seems the less important factor.

- When entering the stable/barn farmers pay most attention to climate/air quality, disease symptoms and feed availability, followed by animal condition and water availability.
- Feed intake and disease monitoring are the most important inspection tasks which respondents want to have automated.

Key indicators based on the questionnaire are:

The five most important **social key indicators** of PLF are:

- 1) Labour conditions (physical, dust, environment, light...)
- 2) Number of labour hours
- 3) Pride/motivation to talk about and show animal and production facilities
- 4) Availability of advisory systems
- 5) Successor for farm business to continue the farm

But also job satisfaction, participation in a study group for farmers, risk awareness, attractiveness of the farm to external investors and social recognition for a job well done are important.

The five most important **economic key indicators** of PLF are:

- 1) Feed conversion
- 2) Growth
- 3) Health costs
- 4) Delivery weight
- 5) Energy costs

But also uniformity, mortality, farm income, noble parts/units and control of waste production and manure are important.

1. Introduction

Precision Livestock Farming (PLF) develops management tools aimed at continuous automatic monitoring of animal production, which includes real-time monitoring of growth, health and welfare. Sensor technology integrated in monitoring systems allows farmers to follow the animal's status and observe their performance, detect diseases and other welfare problems at an early stage. In addition with the help of this technology, farmers and veterinarians can continuously and automatically collect and manage the information needed to assure citizens that livestock production is safe, welfare friendly and environmentally sustainable. It intends to support farmers and service providers in their daily management with extra eyes, ears, noses and hands, and make them more independent from the availability of human labour. Technology helps to detect needs of individual animals, sometimes even better and earlier than the human observation.

A cornerstone in successful management of large herds is to combine information on individual animals with feed composition and rations, environmental conditions and management routines in order to achieve optimal productivity, welfare and health and simultaneously avoid over-feeding and feed wastage. A substantial amount of data is collected which has to be converted into useful information and decision support systems for farmers and service providers. To support this with PLF technology requires the development of mathematical decision support modelling, (wireless) sensor technology, ICT-infrastructure (web based, databases), standardisation (e.g. RFID) and user-centric design methods to evaluate the interest of cumulating data from different origins (biological, behavioural...) and the improvement of the quality of the diagnosis and support. PLF technology will assist the farmer with daily management choices, in areas with social, economic and technological issues.

New technological developments as described above will make the management activities of farmers and service providers more efficient and objective, and facilitate farming practices that reduce waste and emissions, detect early irregularities and improve welfare and health. However, the biggest impact is that farmers will be supported in providing care to individual animals that are part of groups, and taking care of the circumstances in which these groups have to function. PLF is a system innovation, affecting socioeconomic variables.

The impact of PLF on social and economic aspects is not well known. In order to be able to study these social and economic effects this deliverable gives the results of an initial view on key performance indicators (KPI) for these aspects. The objective with this survey is to conduct an interactive session where the farmers, retailers and feed providers are exposed to a number of "trending topics", e.g. environment, animal welfare, tail cutting, antibiotic reduction, etc (see also illustration in Figure 1.1) and to brainstorm of the items/things/indicators they see as important from the social and economic perspective. Also to test the relevance and validity of the KPIs

identified in this research. The lessons learned will be translated to the blueprint for the EU-PLF project.

This work summarises in chapter 2 the initial list of socio and economic indicators that was set up by experts and a small literature research. These results were validated and enriched in chapter 3 that gives the result of a workshop in the Dutch-Flanders area where the production chains are not integrated and chapter 4 that summarises three interviews in the integrated chain approach in the Catalan region. These results were used to set up a web based questionnaire to come to the list of key indicators. The results of this questionnaire are given in chapter 5. This report ends in chapter 6 with the lessons learned for the blueprint.

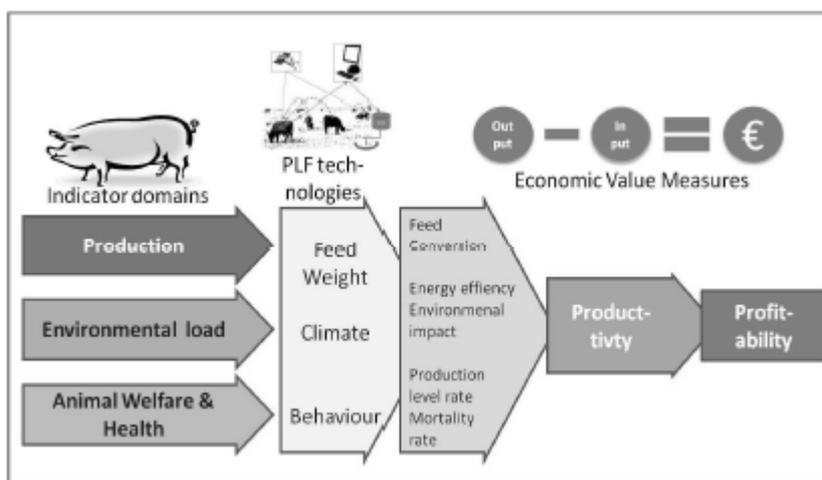


Figure 1.1: Illustration of Economic value management (from DOW EU-PLF project plan)

2. List of socio- and economic key indicators

The experts of the EU-PLF work group on value creation have created an initial list of social and economic key indicators. This is based on their existing knowledge of literature and their perception of what PLF tools and services might look like.

Literature research

Before starting the literature research, some key-words have been determined. Those key-words are: pig, poultry, dairy and calves, economic, investments, ROI, farm level, process level (feeding, animal care and milking). The sources to look for those key-indicators are: Agrovision reports (pigs and poultry), administration reports, KWIN¹-Livestock production, Scopus <http://www.scopus.com/home.url>, Internet and experience from experts.

Agrovision reports (with characteristics for pigs and laying hens), administration reports and KWIN-Livestock production supply the most important economic indicators. The social aspect has been introduced most by experts.

Searching on Scopus with the query: TITLE-ABS-KEY(**socio AND economic AND livestock**) supply 635 papers about socio-economic issues. Most of these are related to rural countries. Some relevant titles are:

- Younge, B., Vial, C. (2012) Socio-economic impact of horse production on rural areas: A comparison between Ireland and France In: EAAP Scientific Series 132 (1) , pp. 453-466.
- Sindato, C., Karimuribo, E., Mboera, L.E.G. (2011). The epidemiology and socio-economic impact of Rift Valley Fever in Tanzania: A review, Tanzania Journal of Health Research 13 (5 SUPPL.ISS) , pp. 1-16
- Battelli, G.(2009) Echinococcosis: Costs, losses and social consequences of a neglected zoonosis Veterinary Research Communications33 (SUPPL. 1) , pp. S47-S52
- Mwirigi, J.W., Makenzi, P.M., Ochola, W.O.(2009). Socio-economic constraints to adoption and sustainability of biogas technology by farmers in Nakuru Districts, Kenya Energy for Sustainable Development13 (2) , pp. 106-115

Mwirigi et al (2009) is one of the few authors who explain what they understand by socio-economic issues: Socio-economic status of a farmer in the study included the level of education of the family head, family income, size of the farm, farm ownership, farming system, number of dairy cattle and the average cost of a dairy cow in the area.

Consulting those different sources resulted in the following initial indicators, as shown here in no particular order :

¹ KWIN = Quantitative Information Livestock Production

Initial Economic indicators: (different per animal category)

- Feed conversion (kg/kg) → less waste production & manure
- Growth (g/day) & noble parts/units (breast meat, 1st grade eggs, mastitis free, ...)
- Uniformity (less slaughter waste and lean productions)
- Mortality (%)
- Energy costs (€/animal) /pig/hen/lactation/veal calve → LCA (C-footprint, water footprint)
- Price (€/kg)
- Feed price (€/100kg) (incl. medication)
- Health costs (€/animal) /pig/hen/lactation/veal calve [prevalence of diseases]
- Labour costs (€/h)
- Investment costs (€)
- Depreciation (€)
- Environmental pollution (can also be social)

In general it can be seen that a combination of technical production and financial results (like costs and revenues) is needed. Also there are differences between sectors in the way they look at their pricing mechanisms. This influences the management and the key indicators to measure. Another element came clear that strict definitions of indicators and the way they are calculated is not always clear and might differ per sector and country. Therefore the calculation of the impact of PLF products and services might need a good preliminary choice of how to measure and calculate/prove the added value. In particular, it needs to be considered whether the indicator should be measured on animal, group, farm or chain level. This topic will be addressed in WP4 of the EU-PLF project.

As an exploratory example on economic reasoning the following:

Many factors independently might give us an impression that we have to deal with many issues. In reality the key economical aspect of livestock production is relatively 'simple' and can be expressed with the equation: $Profit = sales\ price - (fixed\ costs + variable\ costs)$. In this equation tax, depreciation and amortization are included in the fix and variable costs.

- *Feed conversion* is an indication of the relationship between essentially variable costs (feed cost being the dominating variable cost i.e. feed price x feed used to produce a unit of animal – up to 70% of total production costs) and sales price (weight gain) Price of animal (€/kg).

- *Growth rate* is/was seen by some as a good indicator of biological performance, but NOT economic performance, as high growth rate can be achieved uneconomically (i.e. too much input!)

- *Energy costs* (€/animal), *health costs* (€/animal), *labour costs* (€/hy), *investment costs* (€) and *depreciation* (€) are usually seen as part of the fixed cost portion of the enterprise. Normally around 30-35% of all enterprise costs and tend to be amazingly stable for individual enterprises. With respect to PLF it can be discussed whether at least health costs can also be seen as variable costs.

- *Uniformity* will increase price paid per animal and mortality (%) will reduce variable costs.
- Environmental pollution can only be considered in the equation if we manage to put some financial value on ecological benefits.

This leads to the following work hypothesis equation:

Profit = sales price (animal weight x Price of animal (€/kg)+ premium paid on uniformity, meat yield, fatness) - (fixed costs: Energy costs (€/animal) + Labour costs €/animal)+Investment costs (€/animal) + Depreciation (€/animal) + Tax (€/animal)) + variable costs: Health costs (€/animal) + feed price x feed used to produce 1 animal + mortality costs))

Initial Social Indicators:

- Labour hours (h)
- Labour condition (physical, dust/environment, light,)
- Working together (size of team)
- Social recognition for a job well done
- Proudness/Motivation to talk and show animal and production facilities
- Cultural situation
- Need to physically present during production process
- Age, education, years of experience of farmer and workers
- Job satisfaction
- Risk attitude
- Participation in study groups
- Successor for farm business
- Availability of advisory systems
- Sound story to attract investors and legislative organisations
- Image of Animal health (lameness, ...) & disease (coccidiosis, ...) & Occupation density / animal welfare (panting, aggression, pig castration, fertility, ...)
- Risk of Zoonosis (Salmonella, Campylobacter, ...) for human and animal populations
- Contribution to Sustainability (protein sources, EU raw materials, ...) → can also be economic

These social indicators are also in a random order. In contrast to the economic indicators these social indicators look more general. So less influence might be expected in the interpretation between sectors and countries.

3. Workshop Dutch-Flanders region

To discuss the social and economic issues with chain partners in the Dutch Flanders region a workshop was organized. The goal of this workshop was to involve stakeholders that operate in a non-integrated production chain. The characteristic is that all organisations, like farmers, feed and breed companies and processing are independent from each other and have to align based on cooperation. We were interested if the stakeholders were familiar with PLF and were capable of giving relevance to the effect of these PLF products and services to the economic and social performance.

To guide the brainstorm we decided to work along the lines of trending topics that are relevant for the livestock production sectors in these regions. These topics were:

- Energy (0-energy, energy producing)
- Environment (emission, air quality, manure, ...)
- Preventive operations and animal welfare (tail biting, boar taint, I&R, transport, ...)
- Animal health (antibiotic free, farm based diseases, zoonosis, ...)
- Product differentiation
- Food safety

In the brainstorm only food safety, preventive operations and animal welfare were discussed. In the brainstorm we tried to stimulate thinking about the whole production chain with segments for breeding, feed, farmer, processing, service providers and in the line of social (including ethics), economic and technical. To get an impression the pictures of the brainstorm can be seen in Figure 3.1.



Figure 3.1: pictures of the forms that were used in the brainstorm session.

The discussion was in Dutch. Results of the yellow-sheets as reminders are translated and shown in the following tables.

Product differentiation		Not discussed in brainstorm but some remarks belong to this topic	
	Social (ethics)	Economic	Technical
Breed industry			
Feed Industry			<ul style="list-style-type: none"> Labelling of products is needed: how can this label be filled with information from the production process
Farm systems (including farmers)	<ul style="list-style-type: none"> Utilise healthy aspects from the resources: example healthy aspects of milk 	<ul style="list-style-type: none"> Example of boars: how to take care of market dynamics in the production and logistics of the chain 	
Processing Industry			
Service providers			
Others			



Food safety	<ul style="list-style-type: none"> If you do not address or take care for food security it will be <u>dramatic so food quality is a must</u> Media play an important role: objective, measure, problems There is a 0-tolerance culture with regard to food quality To communicate on food quality is also beneficial to farmers (Promotion) 		
	Social (ethics)	Economic	Technical
Breed industry			<ul style="list-style-type: none"> Improve resistance through genetics
Feed Industry	<ul style="list-style-type: none"> Is it possible to create a list of producers that have high food safety results: support of farmers choice Image of trustworthiness should be communicated to consumers Collective responsibility for creation and maintaining open markets 	<ul style="list-style-type: none"> Guarantee the feed material Qualitative raw material for low production costs and free of contamination (pesticides); focus on proteins Secure though certification 	<ul style="list-style-type: none"> Salmonella free food Treatment of food (Salmonella)
Farm systems (including farmers)	<ul style="list-style-type: none"> Isolate individual animals and (re)mark them Define conditions and make them transparent: now most of the time on paper, but it is a chance if you can make this automatic and real time (GMP as example) Very important for society and therefore for the social contacts: it is natural to take care of food security Uniformity in groups of animals will ease work processes and work load 	<ul style="list-style-type: none"> Insurance need can be supported by addressing food safety 	<ul style="list-style-type: none"> Level playing field for using the same set of standards Need for controlled processes
Processing Industry	<ul style="list-style-type: none"> Create Unique Selling Point for Quality Assurance with adequate checks LABEL for products 	<ul style="list-style-type: none"> Increase revenues by addressing social indicators 	
Service providers		<ul style="list-style-type: none"> Lab test are needed for Mycotoxins and Bacteria Risk factors should be identified 	<ul style="list-style-type: none"> Develop 'quick tests' for early warning (think of dipsticks for milk, blood, urine)
Others	<ul style="list-style-type: none"> Be aware that constant high quality is needed: no incidences are allowed 	<ul style="list-style-type: none"> Zoonosis and toxins 	

Preventive operations and animal welfare			
	Social (ethics)	Economic	Technical
Breed industry	<ul style="list-style-type: none"> Hornless breeding Prevent caesareans Sire choice Tracing predisposition through individual animal 		
Feed Industry		<ul style="list-style-type: none"> How to measure Feed Conversion (also for boars) 	
Farm systems (including farmers)	<ul style="list-style-type: none"> Measure boar taint form non castrated boars How to release farmer in his 24/7 job for taking care of animal: increase certainty predictability Reasoning from perspective of an individual animal 		<ul style="list-style-type: none"> Ear sensors: activity, eating and rumination behaviour, temperature Measure behaviour to keep tails intact Measure pain through blood sampling and sensing Use a chip to measure animal characteristics
Processing Industry		<ul style="list-style-type: none"> Measure boar taint from non-castrated boars to guarantee .. 	
Service providers	<ul style="list-style-type: none"> Integral investments in research in order to benefit from chain profit and cooperation Pro-active funding and communication with NGO's 		<ul style="list-style-type: none"> Knowledge of the <u>cause</u> is needed instead of focusing on solutions
Others	<ul style="list-style-type: none"> Information – why is a certain preventive operation needed Back to basics = nature Dialog is needed Definition of welfare Need for normative values 	<ul style="list-style-type: none"> European legislation: how interpreted and implemented per country and what are the consequences for farmers and other stakeholders Preservation should be on right 'European' level 	Collective research is needed

From this workshop the following observations and generic insights can be extracted:

- We had an enthusiastic and diverse group. It was quite easy to have discussions in the group.
- Most stakeholders were not acquainted with Precision Livestock Farming and it was quite difficult to discuss on the basis of examples of products and services. Where appropriate the moderator brought in some examples. A particular PLF product was briefly discussed when dealing with the technical aspects for farmers in the area of welfare. One of the dairy farmers uses the 'Sensor' system and could show the system on his mobile phone. Since he is working with the system the intermediate calving time decreased with 15 days, which is a big improvement.
- Promotion activities and awareness for PLF added value might be needed instead of criticism of the present production methods in livestock farming.
- It was clear in the discussion that food safety is a core feature of the brand image of the business. The stakeholders argued for a transparent system and for a level playing field. Systems like GMP are introduced, but most the time there is a lack of control. PLF might be very helpful in 1) measuring food

safety aspects like salmonella, pesticides, bacteria, .., 2) providing real time information electronically and 3) standardise data capture and distribution. This will increase the impact of quality control, but also its effectiveness and efficiency.

- It is most of the times very complex to connect observations to the real cause of problems and most of the time knowledge is still inappropriate. PLF applications also are faced with this difficulty.
- To prevent 'scandals' it is needed to improve the production process and to be able to handle the dynamics of the production system and context. PLF can play a role in this. If scandals happen they have a very high impact on social life and economic performance.
- It seems in a lot of discussions that the expectation is that PLF products have a high sensitivity and specificity. This might give problems in the social context since measuring system, models and decision support systems all deal with errors (of different kinds) and uncertainty. This phenomenon needs a special place in the communication on PLF products and services.
- Main drivers in the social and economic area are: communication, transparency, timeliness, dynamics, and take care of certainty/risk.
- On the case of 'Krulstaart' (intact curly tails) it was clear that there is added value and improved brand image if tails are not removed. However, the biggest obstacle is the risk for the farmer. If tail biting starts then the economic consequences are quite large; in addition consumers react negatively to pictures of severed animals. It takes a lot of courage of farmers not to cut the tails and risks are not dealt with in the price and the societal discussion.
- Chipping of pigs (electronic Identification and registration) will only be introduced and beneficial if it is introduced on EU level and if it is standardised.
- In the discussion, labour was not an issue. This was for the amount of labour and also for the quality of labour and the labour circumstances.
- In the discussion we did not get down to the level of socio-economic indicators that we had earlier identified in our short literature research. The lack of concrete PLF products and services did not allow for the discussion to get to that level.

4. Interviews of integrated pork chains in Catalonia

In Catalonia (Spain) we performed in-depth interviews with three integrated companies. In the interviews we tried to get insight into their performance indicators and whether these are related to social and economic indicators that can be related to PLF products and services. The following three integrations were interviewed, followed by an extract of the minutes of these interviews:

- Grup Alimentari Guissona, www.cag.es
- Selección Batallé, www.batalle.com
- Cooperativa Plana de VIC, www.planadevic.cat

The Grup Alimentari Guissona (GAG)

Group Alimentari Guissona started out as a farmers' cooperative with the idea to market their own products. Since then, the group has grown and diversified considerably. At a certain point, the cooperative base stopped being viable and a Sociedad Anónima (S.A.) was founded. Workers and members of the cooperative were offered shares; the cooperative itself still runs the animal production and remains GAG's largest shareholder. The group covers the whole value chain from feed – grow out – slaughterhouse – retail. The aim of the group is to be a fully integrated operation always aiming at the final consumer. The group also seeks operational advantages; for such reason they have established for example an insurance arm and started a network of gas stations – primarily for own consumption, but always providing the service to consumers (or businesses).

Their retail arm actually has two branches:

- A network of supermarkets with focus on meat, but with all other kinds of goods
- A chain of self-service restaurants of the “all you can eat type” with the additional trick that users cook their own meats, toast their own bread and toss their own salads

The group believes in delivering standard products of excellent quality at exceptional prices; main marketing is based on the fact that GAG delivers products directly from the farm to the consumer. One challenge of this model is a generalised belief that “well priced” is equivalent to “cheap”. Every unit of GAG is considered (and established independently). However, not all units are designed to make profit; some units simply have to cover their own costs.

In pigs, GAG runs two quite different product lines:

- “White pigs”, meaning standard pigs as found elsewhere and their products. Lean meat is appreciated;
- “Back pigs” or pigs of the Iberian race which have completely different sub products; Iberian pigs are highly esteemed for their hams which in general requires fatter pigs

For products from “white pigs”, GAG attempts to have a single product per category, i.e. one sausage for frying, one type of cutlets etc. This leads to a single slaughter specification.

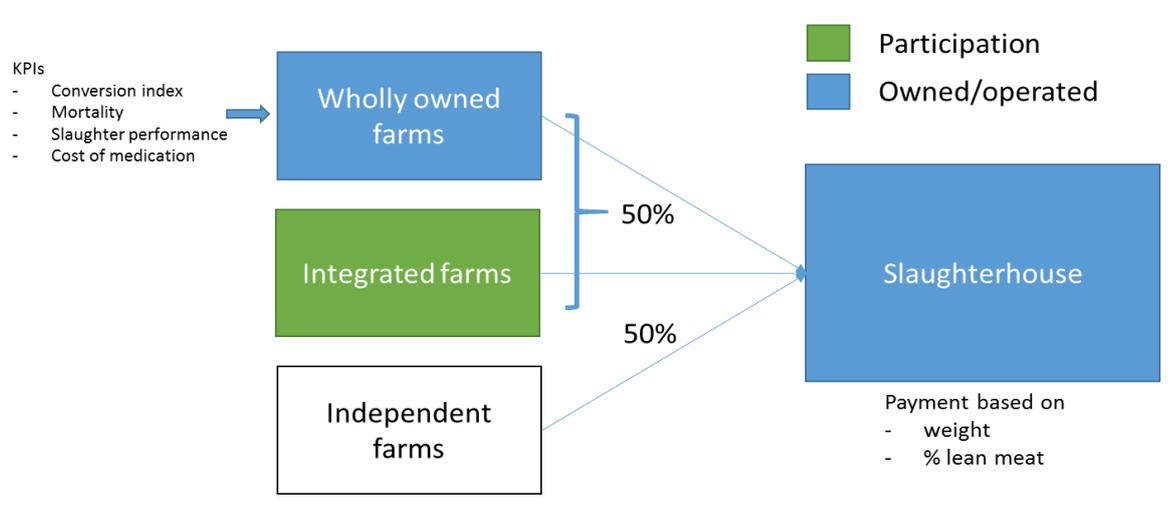
The GAG prides itself in being a reliable and foreseeable business partner. They might not compete on price, e.g. for pigs at the slaughterhouse, but they will pay the “standard price” (known as the Lleida price) – not more, not less. Transparency and reliability are important business values for GAG.

The key group economic indicator for white pig products along the chain would therefore be €/kg of meat.

Feed is produced at various locations and sold at market price. The group produces all kinds of feeds, including consumer products such as pet animal feed. Thanks to the nature of an integrated enterprise, GAG has access to a number of data elements from the grow-out. However, there is no feedback loop as proposed in ALL-SMART-PIGS. In particular, since the feed operation has no “real-time” access to weight data, there is no feedback on the effect of a recipe change on weight (or health or behaviour of the animals). The feed company provides veterinary services to its contractors as part of their service. Feed will exclusively come from GAG for own and rented farms and for most integrated farms. Some integrated farms however run several grow-out cycles at the same time for which they might use different feed providers. Integrated farms serve a one market “regulation instrument”. Since GAG oftentimes only purchases a certain percentage of their production, in case of material shortage at the slaughterhouse, integrated farmers will be asked to provide more animals.

Types of farms:

OWNED	RENTED
<ul style="list-style-type: none"> • Farm installations and land owned by GAG • Farm personnel are employees of the group 	<ul style="list-style-type: none"> • Farm installations and land rented from 3rd parties • Rest identical to owned farms
<p>INTEGRATED FARMS</p> <ul style="list-style-type: none"> • External farms • Farmer independent professional; owner of installations • Animals and feed owned by GAG 	



KPIs

- Conversion index
- Mortality
- Slaughter performance
- Cost of medication

Legend:

- Green box: Participation
- Blue box: Owned/operated

Flowchart:

- Wholly owned farms (blue box) and Integrated farms (green box) both have arrows pointing to Slaughterhouse (blue box) labeled 50%.
- Independent farms (white box) has an arrow pointing to Slaughterhouse (blue box).
- Payment based on:
 - weight
 - % lean meat

Operators of owned farms are paid a fixed salary and a variable complement. The variable complement depends on the following KPIs:

- Conversion index, i.e. feed spent during fattening vs total weight gain during fattening (pigs are not weighed until despatched to slaughterhouse)
- Mortality
- Performance at slaughterhouse (i.e. how often they meet the target specification)
- Medicine cost

Management procedures depend heavily on the farmers, but typically these would be the first (and only) three things to observe in order of importance

- Dead animals
- Feed/water – it seems the water nipples break off easily and it depends totally on the farmer when they are replaced. There is no warning system
- Coughs and diarrhoea

GAG operates its own **slaughterhouses**. A small percentage of animals (about 5%) are slaughtered in external slaughterhouses. This has two purposes: one is to “take the pulse” of the market, i.e. gathering of market intelligence and continuous improvement. The second purpose is to have another “security valve” when there is excess of material. In consequence, some material has to be moved every week to those slaughterhouses to keep the goodwill which slightly decreases the overall margin, but assists greatly in risk management. Slaughterhouses typically performs secondary processing services (the result is therefore typically not a carcass, but further process raw meat products). There is no product differentiation, i.e. one meat quality only. Slaughterhouses pay typically the standard price (Lleida price) on the following specification: 75-93kg carcass weight, 62% lean meat. For white pigs, if the lean meat percentage is higher, more will be paid. If the lean meat contents is lower, a lower price will be paid. Off-spec animals will be paid according to the “distance” to spec, i.e. a pig that is just 1kg off spec will fetch a better price than pig that is 10kg off spec. The slaughterhouse has a complex and sophisticated material prediction system. They get birth data from own farms every x months. This data is later corrected for dead animals. In addition they have developed over time a relationship between months of the year and probable growth rates. As a result, slaughterhouses make an annual slaughter plan. Farmers call in their deliveries a week ahead; the slaughterhouse confirms that they can deliver or re-negotiates.

The **high-value Iberian** pigs have quite a separate value flow. The feed is different, farms are different and slaughter specification is very different. The highest value pig products derived from Iberian pigs “bellota” and “dehesa” are regionally regulated. In Catalonia, main operational area for GAG there are no municipal areas that may produce these products. GAG does grow Iberian pigs on (specialised) pig feed which may be called “Iberic” but not “bellota” or “dehesa”.

As an **integrated operation** they have access to all kind of information. However, there is e.g. no pig weighing, so growth predictions are not adapted to real data. GAG showed strong interest in the technologies tested in ALL-SMART-PIGS and EU-PLF and expressed an interest to test a selection of them in their own farms. Specifically mentioned is that integrated farms as a “problem” for indicator calculation, since they typically run different systems and may very well not have the exact same methodology. For example, feed consumption by dead animals may be calculated differently when contributing to final growth indicators. *Standardisation* would clearly be very helpful, but might not be easy to achieve.

Animal welfare is an important subject for the group. For example, all slaughterhouses have been adapted and use anaesthesia via gas. However, there is no consumer appreciation in Spain. Their clients preferred them over other providers for the combination of quality, control of the process (“nearness” to the farm) and price. Welfare is a legal issue for CAG, not a marketing/brand image issue. No farms are independently

certified for animal welfare. RGS had heard of one slaughterhouse in Aragon (not owned by CAG) that had a number of certified farms for export, mainly to the UK.

Animal health is obviously of concern to CAG. Animal health is measured by:

- % of mortality
- % of runts
- General state (free text comment)

Veterinary costs are absorbed by CAG and the individual vet cost per farm is not monitored. However, for owned farms, farmers are paid a variable salary that depends partly on cost of mediation.

Fattening farms of CAG have with very little exception no ventilation systems. Therefore the main **energy cost** is heating in the winter. Farmers are re-compensated for their heating cost. CAG guarantees a certain temperature for the pigs and pays the fuel to maintain this temperature. This is, however, not a precise procedure. Only for problematic farms, CAG deploys temperature sensors.

CAG has an own **manure management** plan that includes a nutritional profile designed to reduce nitrogen in manure. Operations that have such a plan, can apply for a reduction of the amount of land they have to have access to deposit the manure. This reduces the cost of the operation. Farmers have to keep records about where their manure goes, so the public administration can audit their compliance to the manure management plan.

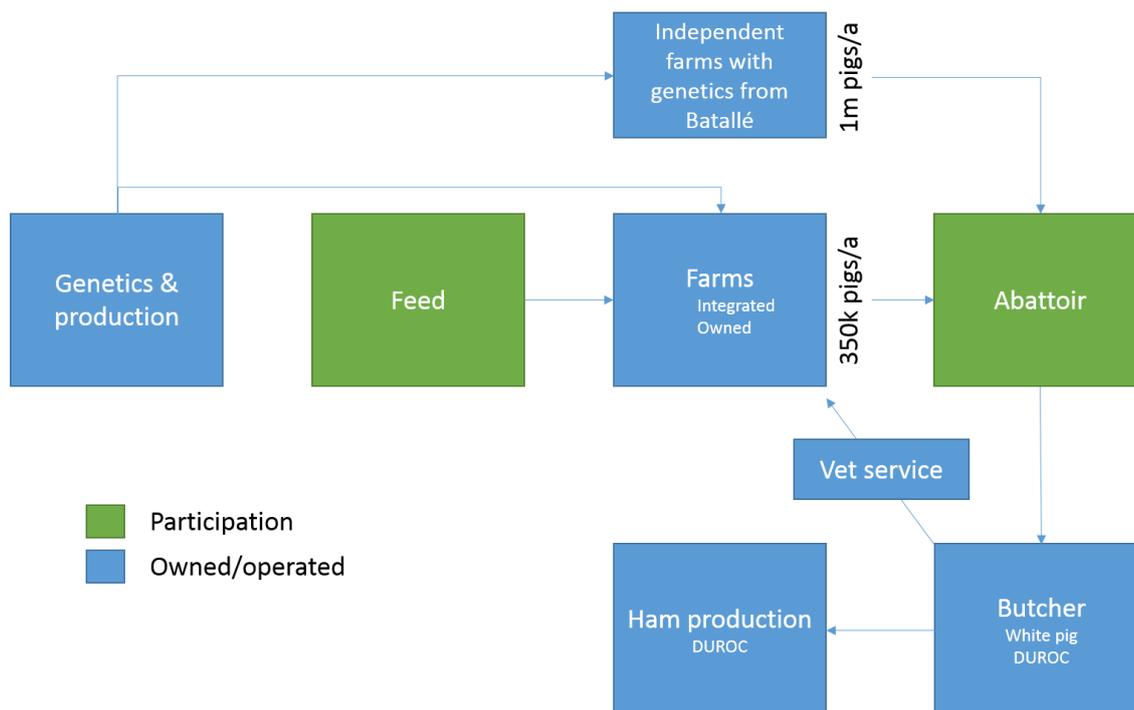
In fattening, there is no particular qualification needed for **workers**. Given the current employment situation in Spain with about 27% of the workforce unemployed, there is no shortage of unskilled labour. However, in reproduction, i.e. on sow farms qualification is required and good people are scarce. CAG has problems staffing these farms.

Fattening at CAG is a straightforward operation very much streamlined for economic performance. Therefore the areas **of interest for PLF** solutions are

- Feed
- Weight gain and deviations from the estimated growth curve
- Water problems, that might be detected by sound

The Selección Batallé group (JRS)

The Batallé Group started out as a pure genetics company, but has moved in recent years more and more into production. The Group has the following components:



The group now covers the value chain from genetics – feed – grow out – slaughterhouse. For their Duroc species there is an own distribution to HORECA and butcher shops.

Batallé produces two very different product lines based on:

- “White pigs”
- Duroc pigs

For white pigs, the strategy of the group is to deliver a “standard” product (see below) in large volumes for a good price. The products are exported world-wide and mainly sold to the transformation industry with some sales to retail. For Duroc, the strategy is quite different. Duroc products are marketed on their exceptional quality, in particular the fat distribution in the meat. Duroc cured hams are sold mainly into the Spanish market. Duroc fresh meat is sold to HORECA and specialised shops. All units of Batallé are considered (and established independently). However, not all units are designed to make profit; in particular feed production and slaughterhouse are considered a service and paid as such. In these entities Batallé holds a participation and is not the sole owner. The key group economic indicator for white pig products along the chain would therefore be €/kg of meat.

All owned or integrated farms from Batallé use their own **genetics**. Genetics used to be sold freely on the market, but in recent years Batallé has a tendency to sell its genetics only to providers of their slaughterhouse. One can say that a very large percentage of Batallé pigs ends up being slaughtered in their own slaughterhouse. Batallé’s “white” pigs is not quite the standard mix. In Batallé the white pigs has 25% Duroc, 50% Pietreenc and 25% Landers. Duroc pigs are pure.

Feed production is considered a service. The feed provider is given the specification by Batallé’s nutritionists and is paid a fixed amount per feed produced. Price variations in raw materials are managed by Batallé and therefore feed production is risk-free. The feed company is a 50:50 joint venture with Taradellas

(who use a similar system). Given the growth of both groups, little feed ends up on the free market. Batallé uses 3-4 different feed formulations in the grow-out process.

Types of farms:

OWNED	INDEPENDENT
<ul style="list-style-type: none"> • Farm installations and land owned by Batallé • Farm personnel are employees of the group 	<ul style="list-style-type: none"> • Independent farmers using genetics from Batallé • Typically deliver a large portion of their material to Batallé's slaughterhouse
INTEGRATED FARMS <ul style="list-style-type: none"> • External farms • Farmer independent professional; owner of installations • Animals and feed owned by Batallé 	

From the perspective of slaughtered animals about 25% comes from owned and integrated farms. In grow-out, about 80% of the farms are integrated and 20% owned. In sows, the percentage is reversed. Batallé has an own veterinarian/technical service that is made available to owned and integrated farms. Each farm has a coordinator from Batallé who meets farmers weekly and discusses issues with them. The following indicators used on farm level are discussed weekly with the coordinator:

- Average weight gain/day
- Conversion index (kg feed to kg meat)
- % of mortality

Farms have a **management plan for manure** but no measurements are made. Veterinary cost is not monitored directly; however the coordinator would know if there was a generalised health problem on a farm and would seek a solution together with the farmer. JRS also felt that the mortality already gave a good indication for health problems.

There is little understanding of **social indicators** (e.g. availability of workforce, attractiveness of workplace etc). The only thing that could be confirmed was that in the current climate in Spain, it is a lot easier to source personnel even locally and that there was no shortage of workforce. Animal welfare is also an important issue for farmers and quite a number of them are certified or seeking certification – mainly for export.

Batallé uses one **slaughterhouse** of which they own a certain percentage. 95% of animals slaughtered in this abattoir stem from Batallé's own genetics. Batallé was very clear that the quality of the end produce was considerably more consistent because they controlled the genetics. However, other factors such as stress, management practices and feed are currently not fully controlled. The slaughterhouse pay standard price on the following specification:

- White pig : 82-83 kg carcass weight, with certain % of lean meat
- Duroc pig: 93 kg carcass weight, lower lean meat %

The slaughterhouse is considered a service and does not own the pigs. They are paid a fixed price per slaughtered pig. JRS was not quite clear on the influence of stress on the meat and on what the exact procedures were to lower the stress level of the animals. In the slaughterhouse data is captured that allows to calculate indicators such as kg feed / kg carcass. This data would be the basis for calculating € spent on feed/€ received for meat. Batallé has recently undertaken a national project funded by CDTI (the Spanish

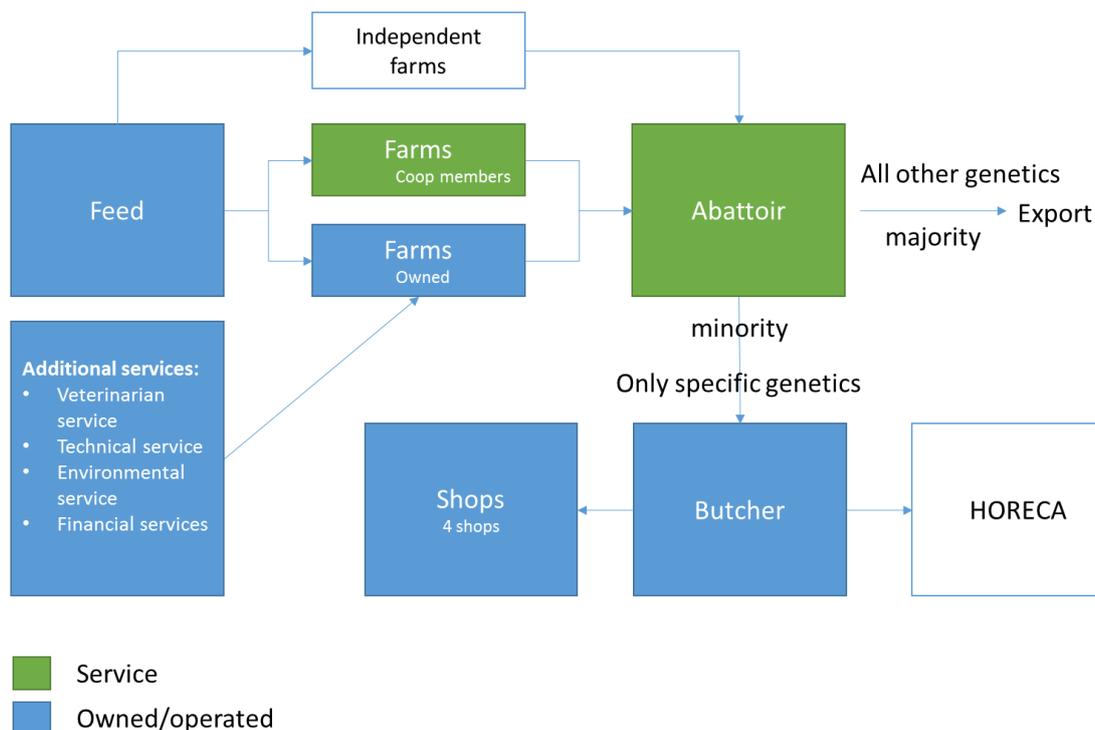
innovation support agency) on improving the genetics with respect to performance at the slaughterhouse. As part of that, Batallé has made a radical change in their optimization strategy. Instead of attempting to optimise the pure breeds which are the base for the genetics of Batallé, the main optimisation target is now the mix-breed animals that arrive at the slaughterhouse. Optimising genetics is still done using trial and error as a main tool. The carcasses are then butchered to make Batallé’s final products. These products are then mostly sold to the transformation industry and not to retailers for consumption. At the butcher a number of indicators are measured to determine the quality of the product, in particular meat colour and pH (to determine water content). Any quality problems are not likely to be raised with the slaughterhouse, but rather directly with the farm through the technical coordinator.

The **Duroc-based** product line works very similar to the above described process, only that slaughter specifications are very different (heavier, fatter pigs) and that in consequence the feed is very different. Here the main optimisation parameter is the good distribution of fat in the meat, which requires e.g. limiting corn as an ingredient. The ham is cured 24 months and some fresh meat is sold to specialised HORECA businesses.

JRS claimed that as an integrated operation they have access to all kind of **information**. However, there is e.g. no pig weighing, so growth predictions are not adapted to real data. JRS did not feel that data delivered from integrated farms are a “problem” for indicator calculation; Batallé simply expects that data will be captured slightly differently and they post-process the data for their internal comparisons. Animal welfare is an important subject for the group and farmers increasingly seek certification, in particular for export. However, JRS felt that there is no consumer appreciation in Spain. Batallé does not itself market their efforts in animal welfare.

Cooperativa Plana de Vic (AF)

Cooperativa Plana de Vic has the following components:



Founded in 1966 by cattle-breeders from Osona with the objective of coordinating the farming activity of the region and covering the necessities of the farming world. The cooperative Plana de Vic (CPV) is devoted to the production of feed, the commercialization of products resulting from farming activity and offering veterinary and financial services to its members. The cooperative was founded by small farmers who were too small to survive. CPV covers feed – to limited extent grow out – processing and retail. The company is only partially integrated and therefore all steps are considered separately when looking at economic performance. However, there is a monthly director’s meeting where prices are adjusted and where all parts of the exploitation come together. The retail arm of CPV only commercialises one product of one particular genetics. Slaughter is considered a service and paid by slaughtered animals. CPV retails only a smaller part of the animals that are grown with their feed – the core business of CPV. CPV tries to differentiate itself on the market by providing mid-priced high quality products.

There is no overall group indicator. AF found the idea of an overall indicator, such as the ratio of € per kg meat sold/feed ingredient cost, very interesting. The traceability system that will be trialled in ALL-SMART-PIGS might provide a platform to gather the necessary data to calculate such an indicator.

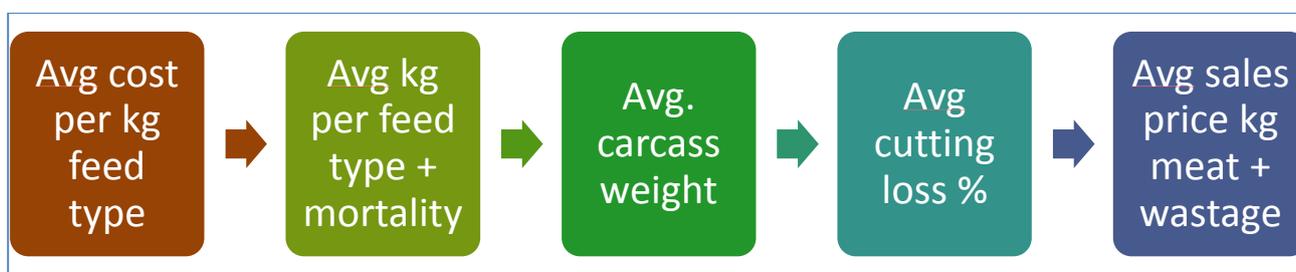


Figure: Example for chain-wide indicator of the economic efficiency

Feed production is CPV’s core business. CPV has for each feed type a fixed specification, elaborated with own and external nutritionists. These specifications have the status of a service level agreement, since they form the basis of the feed agreement with the farmer. CPV typically has long-term relationships to its clients. CPV determines the best feed composition on the basis of current feed ingredient market price and their service level agreement. The company holds monthly meetings where the price of feed is determined based on feed ingredient cost, minimum margin and market intelligence (in particular, AF mentioned Guissona’s feed price published each start of the month). CPV uses 3-4 different feed formulations in the grow-out process.

CPV includes for the pig sector the **veterinary service** in the feed cost. CPV has three vets, all employed and does not monitor the per farm veterinary cost. The feed company monitors on a number of client farms (in particular those farms that are owned by CPV or by the members of the cooperative) the conversion index which looks at weight gained over the fattening period divided by feed required for the weight gain. This is done as a service for farmers, but also an important indicator for value creation of the feed part of the business.

Types of farms:

OWNED	INDEPENDENT
<ul style="list-style-type: none"> • Farm installations and land owned by CPV • Farm personnel are employees of the group 	<ul style="list-style-type: none"> • Independent farmers, some of which use the genetics specified for retail products of CPV
FARMS of members of the cooperative <ul style="list-style-type: none"> • No direct influence by CPV • However, not quite the same situation as with independent farmers either 	

Most farms that use CPV's feed are owned by members of the cooperative or independent farmers. CPV has a few own farms. For their retail and HORECA arm, however, the company prescribes a certain genetic mix. Meat from animals not having that mix will not be sold through the shops or into hotels, restaurants and catering services. For fattening pigs the only indicator that is controlled is the conversion index. Since pigs are not weighed during fattening, the index is measured only at the slaughterhouse, i.e. the end of the process. Having access to "real-time" data is therefore very interesting, according to AF.

CPV provides **environmental services** to its clients. In particular, the company has started 12-13 years ago an environment management plan for pig excrements (urine and faeces). The area around Vic has a very dense pig farm population and ground water is contaminated. In addition, Spanish law requires farms to have sufficient land available for the amount of nitrogen that the pig farm is expected to generate. CPV introduced nitrogen management with their feeding plan and reduced thus the need for land – an obstacle to starting a pig farm. CPV has used the certification by the competent authorities of their management plan for marketing their feed – if a farmer wanted to be part of the environmental management plan, (s)he had to buy the feed from CPV. Part of the environmental management is transport of urine to neighbouring districts. Since urine contains a lot of water and is therefore heavy, the company is now looking for alternative methods of disposal with reduced cost. (The neighbouring district is quite happy to receive the urine, since there is a lot of arable farming and they are in need of fertilizer.) For the faeces, CPV is trialling an innovative composting technology with forced ventilation. The resulting product is used as compost and sold through their retail stores or business to business to ecological and/or extensive agriculture, vineyards and gardening firms.

CPV uses **slaughterhouses** as a service and pays per slaughtered animal. The slaughterhouse delivers all relevant information to CPV. Meat quality is monitored at the cutting room, which pays farmers. However, our interview partners had no knowledge about value creation indicators in the cutting room.

CPV attempts to provide high quality meat products for a reasonable price. Marketing of their **retail shops** is based on:

- 1- Selection of raw materials (for the feed)
- 2- Feed
- 3- Animal welfare
- 4- Elaboration and preparation of meat products

Their slogan is: "At your side, right from the start."

Quality is very important, in particular since the home base of La Plana de Vic is very meat-savvy and has lots of alternatives for meat shopping. However, quality problems or improvement potential is not communicated to the feed production.



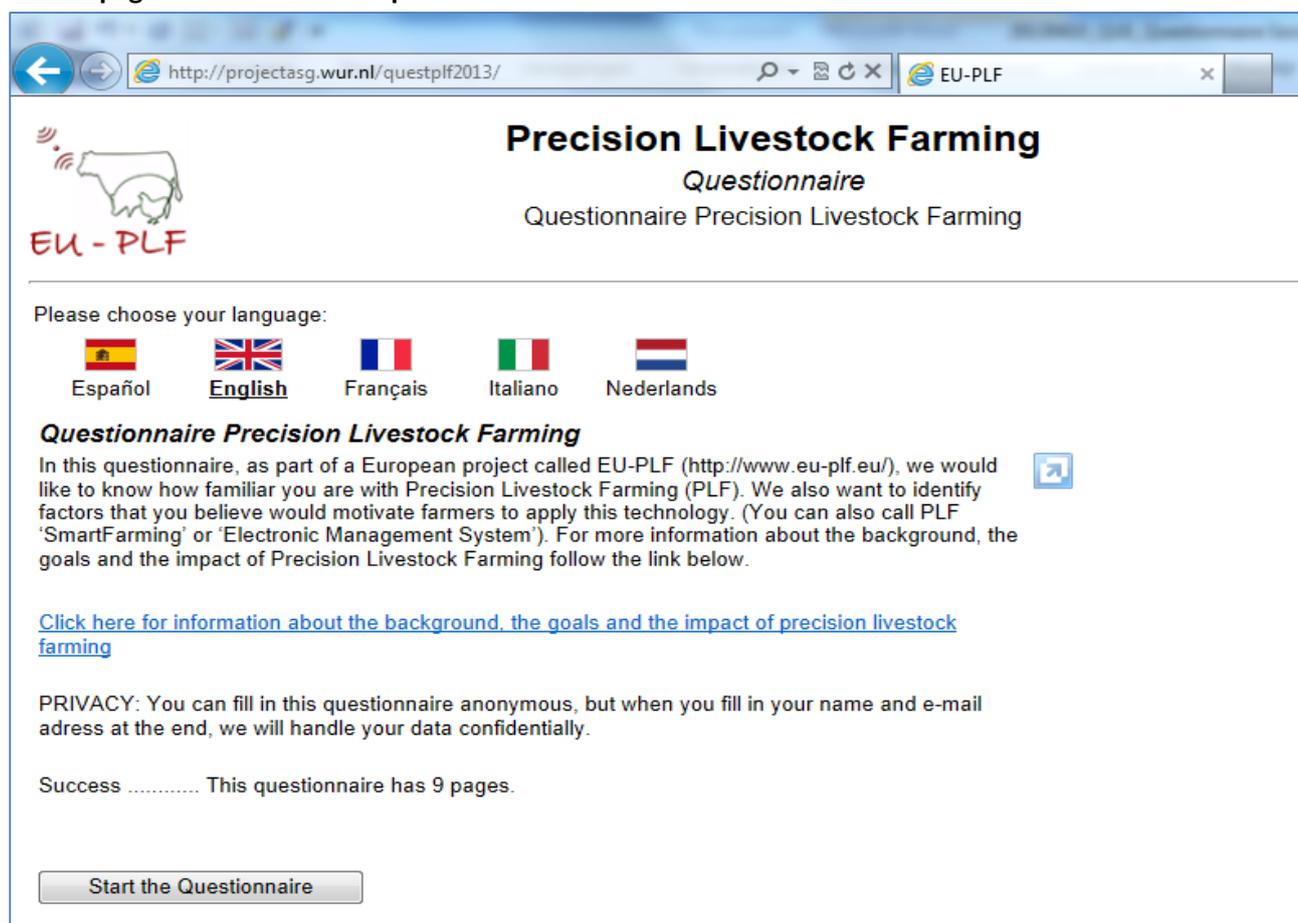
Animal welfare is an important subject for CPV. All farmer members of the cooperative comply with Spanish animal welfare legislation. Most requirements refer to sows and not to fattening pigs. No member has yet sought external certification for animal welfare; in part this is due to a lack of interest of the Spanish consumer.

5. Questionnaire

In addition to the workshop and the chain interviews a web-based questionnaire has been developed. The goal of this questionnaire is to get insight into the social and economic indicators that are relevant for the creation of added value for Precision Livestock Farming (PLF). With help of this questionnaire, we would like to know how familiar stakeholders are with Precision Livestock Farming (PLF). We also want to identify factors that people believe would motivate farmers to employ such technologies.

The survey was developed as a questionnaire with closed and open ended questions. To have a good view of attitude from stakeholders from the whole production chain, a number of 70-80 respondents was targeted. To make it possible for farmers (but also other chain partners) in different countries to fill in the questionnaire, it was translated into different languages. With help of project partners from different countries the questionnaire is now available in five languages and has been spread by e-mail to a large number of stakeholders in different countries. The questionnaire is added as Appendix 1.

Cover page of the web based questionnaire



The screenshot shows a web browser window with the URL <http://projectasg.wur.nl/questplf2013/>. The page title is "Precision Livestock Farming Questionnaire". The main heading is "Precision Livestock Farming Questionnaire" with the subtitle "Questionnaire Precision Livestock Farming". The EU-PLF logo is visible in the top left. Below the heading, there is a language selection section: "Please choose your language:" followed by five options: Español, English (underlined), Français, Italiano, and Nederlands. Below this, there is a paragraph of text: "Questionnaire Precision Livestock Farming. In this questionnaire, as part of a European project called EU-PLF (<http://www.eu-plf.eu/>), we would like to know how familiar you are with Precision Livestock Farming (PLF). We also want to identify factors that you believe would motivate farmers to apply this technology. (You can also call PLF 'SmartFarming' or 'Electronic Management System'). For more information about the background, the goals and the impact of Precision Livestock Farming follow the link below." A blue link is provided: "Click here for information about the background, the goals and the impact of precision livestock farming". Below this, a privacy notice states: "PRIVACY: You can fill in this questionnaire anonymous, but when you fill in your name and e-mail address at the end, we will handle your data confidentially." A success message reads: "Success This questionnaire has 9 pages." At the bottom, there is a button labeled "Start the Questionnaire".

The distribution of the questionnaire was started in May 2013 and within two months there were 87 respondents from more than 10 countries, mostly from Europe. The largest number of respondents came from the Netherlands (34), Italy (11) and Belgium (7). From other countries there are only one to four respondents each.

Table 5.1 In which country you are working in?

Country	Number respondents	Percentage
The Netherlands	34	39
Italy	11	13
Belgium	7	8
France	4	5
Spain	4	5
Sweden	4	5
Hungary	3	3
United Kingdom	3	3
Germany	2	2
Israel	2	2
Denmark	1	1
Other countries	12	14

More than 40% of the respondents are farmers, 20% are researchers, 9% are developers of automation systems and 30% are others like veterinarians, consultants.

Table 5.2 Who are you or what company are you working for?

Company	Number of respondents	Percentage
Farmer	36	41
Developer of automation	8	9
Veterinarian	4	5
Food company (slaughterhouse-milk company)	3	3
Feed supplier	1	1
Other*	35	40

* The category other has been specified by researchers or university, consultants, engineers, teachers and branch organization.

From the respondents 44% are working with dairy, 29% with pigs and 18% with poultry. Only 3% are working with veal calves (table 5.3).

Table 5.3 In which animal section you are working?

Sector		
Sector	Number of respondents	Percentage
Dairy	38	44
Pig	25	29
Poultry	16	18
Veal calves	3	3
Other	3	3

Table 5.4 shows the importance of different factors. **Animal health** is the most important factor, followed by **food safety, environment and animal welfare**. More than two thirds of the respondents choose for the answers related to these topics ‘**a guarantee for the future**’ or ‘**important for the preservation of the sector**’. Society and market orientated thinking scored somewhat lower and control of energy use seems the less important factor. More than one third of the respondents said for energy use: ‘important as long as it gives added value’.

Table 5.4 How important is Animal welfare/Animal health/..... for your business (or the farms you are in relation to)?

Percentage	Answer					
	No answer	... is very important for the government but for me personally it is not	... is important as long as it gives added value	... for me is a guarantee for the future	... is important for the preservation of the sector in my country	Other (please specify below*)
Animal Health	13	1	9	48	29	0
Food safety	15	1	13	36	36	0
Environment	15	1	16	52	16	0
Animal Welfare	11	0	20	34	33	1
Society oriented thinking	16	1	17	34	31	0
Market oriented thinking	16	2	22	34	25	0
Control of energy	13	2	37	33	14	1

*: Animal welfare: all of the above & more Control of energy: also important, but much less so, we do not use energy

Based on a list of eighteen PLF products/services, respondents were asked which products they know, use and are interested in. A lot of respondents (53) know one or more commercial PLF products or services

(table 5.5). Most of them know only one or two, but ten respondents know more than six PLF products. The people who know more products are especially researchers/university staff from the Netherlands or Italy. Fifteen respondents use also one or more products and one person even uses five products. The users are farmers (mostly with dairy or pig) or developers of automation systems (for dairy, pigs and/or poultry) in the Netherlands. One pig farmer with 600 animals uses three PLF products. Eighteen respondents are interested in one or more PLF products. Eight of these respondents are interested in more than six products. Respondents showing most interest in PLF products are from Belgium (feed supplier), France, Spain, Italy, Hungary and The Netherlands and are mainly researchers/university staff.

Table 5.5 Which of the following commercial PLF products/services do you know?

Number of respondents	Know	Use	Interested in
More than 13	4	0	1
6-12	6	0	7
5	5	1	0
4	5	0	2
3	7	2	2
2	12	3	3
1	14	9	3
0	34	72	69

The next products or services are added by the respondents: most of them are used by the respondent, but sometimes they only know them.

- software eliopig;
- AFIFARM
- Q-Wes Lely
- Management system uniform
- RUMA management
- i-onic
- Afimilk management dairy
- Gravitor weighing system
- Farmbox
- Nedap feeding stations for sows
- IceRobotic
- Cowtrack (under development)
- Barn Report
- Nedap location device
- Velfone (Medria)
- AUSPIG
- Plurimix
- Ruminact tags
- Schauer feeding stations for sows
- Bovitemp
- SanPhone (Medria)

The following list gives all the answers on the question ‘Why would you implement PLF in your business ? (Major reason):?’

- in order to improve the efficiency
- In order to help the farmer with the herd management and to fill the gap due to the manpower's poor quality available on the Italian market.
- Advanced tool
- I use it for measuring and controlling livestock processes in my farm. This will result in more output with less input in terms of resources, labour and profitability.
- must have extra value. So reducing the costs (less labour or better results) or increase yield (more milking money while the cows have a better live (must be smart/provable)
- labour efficiency/saving
- control and monitoring health
- good support of the management

- I now use RFID ear markers
- I implemented PLF in 2003-2008 to increase efficiency. 30kg pork to sale. Autosort into five feed groups, liquid feed, phase fed changing feeds daily to each pig according to their weight.
- Massively improved Feed conversion ratio, Average daily gain and enabled me to sell all pigs in a 5 kg window to reduce sort loss to an absolute minimum
- This is done more often in the past (i-onic fine dust); was a good cooperation
- welfare monitoring to allow improvements that can be measured
- animal stream management and by making the animal digital, I have more and better facilities to care for the animal
- better view of the group in the stable and therefore taking better decisions
- To improve feed efficiency and impact
- The management of dairy sheep flocks requires to deal with large numbers of animals. Automation can help adjust the management to individual characteristics or to that of a homogeneous group of animals.
- Sensor technology will result in data that will be turned into valuable information
- Possibility to react sooner on situations.
- More animal welfare, better health, less emissions --> more income
- Agricultural Engineer, making use of advanced technologies to optimize the contribution of each animal in a sustainable way in livestock farming. I am keen on closing the gap between technology, plants, animals, the environment and society. In the adoption of new technology and its integration within existing processes creativity is my contribution.
- To improve detection of disease/production disorders and imply preventive measures or at least to maintain current level as herd size is increasing.
- Traceability
- If the economic efficiency is improved (i.e. if values increases with respect to the cost
- Economic and environmental efficiency
- I am not producer, but if I were I would implement PLF to obtain additional information for decision making.
- I'm a researcher, not a farmer, but I see farmers implementing PLF primarily for labour saving and reduce menial tasks.
- Automation and multiplication of measures (meaning that you can take more measures)
- control of rearing conditions
- Increase in efficiency
- Essential for the future
- It improves management capabilities sufficiently to justify investment of resources.
- Added value for management, use of knowledge and direct feedback from that in practice
- Helps in controlling production, frees time for animal care
- PLF is the future for the animal production sector, in my opinion. It can aid the farmer and enhance the welfare status of the animals. In large farms, farmers need PLF-tools to be able to monitor the animals.
- PLF-tools should be used as a monitoring system that alerts the farmer when something is wrong with his animals or his systems.
- Better care for individual animal.
- Climate control during transport, in animals self.
- Acquisition of data from cattle and sheep
- Management of experimental flocks
- If it added economic value (financial profit)
- Enables only the essential processes to be carried out accurately and consistently over time. Electronic measurement, monitoring, interpretation and control of farm processes is the future for agriculture.

Most of respondents see beneficial impact from PLF on social aspects (table 5.6). Only a few respondents see some detrimental impact. In particular beneficial was the impact on labour condition, the number of labour hours, pride/motivation to talk and show animal and production facilities, availability of advisory systems and successor for continuing the farm. But PLF can also have beneficial impact on job satisfaction, participation in study groups, risk awareness, attractiveness of the farm to external investors.

About the need to be physically present during the production process, the respondents disagree. 35 respondents are of the opinion that this have a beneficial impact on social aspects, but meanwhile 12 respondents are of the opinion that this have detrimental impact. The same happened with working with a number of people on a farm. 30 respondents said 'beneficial impact', meanwhile 9 respondents said 'detrimental impact'.

The respondents also see beneficial impact on economic aspects, especially for feed conversion, growth, deliver weight, health costs and energy costs. But PLF can also have beneficial impact on noble parts/ units (breast meat, first grade eggs, mastitis-free, ...), uniformity, mortality and on farm income. The only detrimental impact they see is on investment costs and derivative from that depreciation.

Table 5.6 SOCIAL aspects PLF; ranking from most beneficial to most detrimental impact (respondents could score from --- (-3) till +++ (3))

Item	Count respondents	Average value
Labour condition (physical, dust/environment, light,)	51	2.0
Number of labour hours	51	2.0
Pride/Motivation to talk and show animal and production facilities	47	2.0
Availability of advisory systems	48	1.9
Successor for farm business to continue the farm	48	1.8
Job satisfaction	43	2.0
Participation in a study group for farmers	45	1.7
Risk awareness	40	1.9
Attractiveness of the farm to external investors	40	1.7
Need to be physically present during production process	35	2.0
Social recognition for a job well done	37	1.8
Working with a number of people on a farm	30	1.8
Age, education, years of experience of the livestock keeper	28	1.9
Cultural situation (differences between countries)	26	1.7
Others (please specify below)	4	2.3
Cultural situation (differences between countries)	25	0
Age, education, years of experience of the livestock keeper	23	0
Working with a number of people on a farm	17	0
Social recognition for a job well done	16	0
Attractiveness of the farm to external investors	11	0
Job satisfaction	10	0
Participation in a study group for farmers	10	0
Need to be physically present during production process	9	0
Risk awareness	8	0
Successor for farm business to continue the farm	7	0
Others (please specify below)	6	0
Pride/Motivation to talk and show animal and production facilities	5	0
Availability of advisory systems	5	0
Labour condition (physical, dust/environment, light,)	5	0
Number of labour hours	3	0
Successor for farm business to continue the farm	1	-1.0
Availability of advisory systems	2	-1.0
Others (please specify below)	1	-2.0
Pride/Motivation to talk and show animal and production facilities	3	-1.0
Social recognition for a job well done	3	-1.3
Age, education, years of experience of the livestock keeper	4	-1.3
Job satisfaction	3	-2.0
Attractiveness of the farm to external investors	4	-1.8
Cultural situation (differences between countries)	4	-1.3
Number of labour hours	3	-2.7

Item	Count respondents	Average value
Risk awareness	7	-1.3
Working with a number of people on a farm	9	-1.8
Need to be physically present during production process	12	-1.6

Table 5.7 ECONOMIC aspects PLF; ranking from most beneficial to most detrimental impact (respondents could score from --- (-3) till +++ (3))

Item	Number of respondents	Average value
Feed conversion (kg feed/kg meat)	51	2.1
Growth (g/day)	50	1.9
Health costs (€/animal or lactation)	48	1.8
Deliver weight	42	2.0
Energy costs (€/animal or lactation)	44	1.9
Uniformity (less slaughter waste and lean productions)	42	1.9
Mortality (%)	44	1.8
Farm income	46	1.7
Labour costs (€/h) as result of other educated employees	40	1.9
Noble parts/units (breast meat, first grade eggs, mastitis free, ...)	42	1.8
Control of waste production and manure	41	1.8
Feed price (€/100kg) (incl. medication)	34	1.7
Price (€/kg or piece) (for example: first grade eggs)	33	1.7
Investment costs (€)	18	1.8
Depreciation (€)	16	1.7
Other (Please specify below)	3	2.7
Feed conversion (kg feed/kg meat)	2	0
Control of waste production and manure	8	0
Growth (g/day)	3	0
Noble parts/units (breast meat, first grade eggs, mastitis free, ...)	7	0
Uniformity (less slaughter waste and lean productions)	10	0
Mortality (%)	8	0
Deliver weight	9	0
Energy costs (€/animal or lactation)	7	0
Price (€/kg or piece) (for example: first grade eggs)	12	0
Feed price (€/100kg) (incl. medication)	16	0
Health costs (€/animal or lactation)	4	0
Labour costs (€/h) as result of other educated employees	9	0
Investment costs (€)	9	0
Depreciation (€)	15	0
Farm income	7	0
Other (Please specify below)	4	0
Farm income	1	-1.0
Energy costs (€/animal or lactation)	2	-1.0
Mortality (%)	2	-1.5
Feed price (€/100kg) (incl. medication)	3	-1.0
Health costs (€/animal or lactation)	2	-1.5

Item	Number of respondents	Average value
Price (€/kg or piece) (for example: first grade eggs)	4	-1
Labour costs (€/h) as result of other educated employees	5	-1.2
Depreciation (€)	18	-1.4
Investment costs (€)	27	-1.8

Table 5.8 gives the priority of observations when entering stable or barn. Climate/air quality, disease symptoms and feed availability are the most important observations, followed by animal condition and water availability.

Table 5.8 Which 3 observations have the highest priority when you enter the stable/barn?

Observation	Number of respondents
Climate/air quality	27
Disease symptoms	26
Feed availability	26
Animal condition (too lean or too fat)	17
Water availability	17
Dead animals	12
Lameness	11
Manure (consistency, colour, odour)	10
Dirt on animals	9
Aggression	6
Other	6
Noise	4

In table 5.9 the perceived added value of monitoring of animal signals is shown. From the respondents one third is convinced that this is the way for the future and 28% think that it can have added value as long as the financial benefit is proven. Unfortunately 34% didn't answer this question.

Table 5.9 Do you think that monitoring of animal signals can have an added value on your farm?

Added value?	Number of respondents	Percentage
I am convinced that this is the way for the future	30	34
I think that it can have added value as long as the financial benefit is proven	24	28
The added value is rather limited because technology is often not reliable	1	1
I don't see the added value for my farm	0	0
Other	2	2
No answer	30	34

Table 5.10 gives a result of the inspection tasks which stakeholders would like to see automated on farms. Most frequently called for are feed intake (37) and disease monitoring (35). Product quality (28), welfare indicators (26), water use (23) and condition of animals (21) are also frequently mentioned.

Table 5.10 Which inspection tasks in your farm would you like to have automated?

Inspection task	Number of respondents
Feed intake	37
Disease monitoring	35
Product quality (eggs, milk, meat etc)	28
Welfare indicators, such as aggression, lack or excess of mobility, non-uniform distribution of animals in the barn, lameness, stress etc	26
Water use	23
Condition of the animals	21
Other (fertility)	4 (3)

Table 5.11 shows the answers about the image of the sector. 40% of the respondents think that by using technology in animal farming, the animal can get a comfortable life and this will benefit the image. 13% of the respondents say that without the technology the sector will not survive. Unfortunately 38% of the respondents didn't answer this question.

Table 5.11 Do you think that usage of PLF-technology in animal farming would harm or improve the image of the sector?

Effect on image	Number of respondents	Percentage
By using the technology in animal farming, we can give the animal a comfortable life and this will benefit the image	35	40
Without the technology the sector will not survive	11	13
Use of technology in animal farming has no influence on the sector's image	3	3
Other	3	3
Too much technology in animal farming is bad for the image of the sector	2	2
No answer	33	38

Of the total population of respondents 39% of the respondents would be willing to participate in the testing of new PLF technologies.

Table 5.12 Are you willing to participate in the testing of these new technologies in your farm?

Answer	Number of respondents	Percentage
Yes	34	39
No, rather not	6	7
No answer	47	54

6. Information for blueprint

This deliverable gives the first rough insights in the economic and social value creation by Precision Livestock Farming. No hard conclusions can yet be drawn from these results. However, they provide some interesting insights that can be used for the blueprint. Within work package Value Creation of the EU-PLF project these rough insights will be used for the setup of more in depth farm analysis of PLF products and/or services that will be used on practical farms. These results will also be used in the further work of the ALL SMART PIGS project.

“Lessons learned”

- Economic indicators are a combination of technical production results and cost and benefit relations. Definitions and price mechanisms differ per sector and region.
- Social indicators can be directly connected to PLF products and services and it seems that there are limited sector and regional effects.
- To calculate the effect of PLF products and services it is needed to have a preliminary choice of how to measure and calculate/prove the added value. Especially on which level it will have influence. On animal, group, farm or chain level.
- In general PLF products are not well known and used, and also normal and existing management systems and automatic systems are seen as PLF products.
- Promotion activities and awareness for PLF added value might be needed instead of criticism to the present production methods in livestock farming.
- It is most of the times very complex to connect observations to the real cause of problems and most of the time knowledge is still inappropriate. PLF applications also are faced with this difficulty.
- To prevent ‘scandals’ it is necessary to improve the production process and to be able to handle the dynamics of the production system and context. PLF can play a role in this. If scandals happen they have a very high impact on social life and economic performance.
- It seems in a lot of discussions that the expectation is that PLF products have a high sensitivity and specificity. This might give problems in the social context since measuring system, models and decision support systems all deal with errors (of different kinds) and uncertainty. This phenomenon needs a special place in the communication on PLF products and services.
- Main drivers in the social and economic area are: communication, transparency, timeliness, dynamics and take care of certainty/risk.
- The business models of the integrated production chain companies in the section feed production – farm – slaughterhouse/cutting room were astonishingly similar. Both companies which occupy very different places in the “ecosystem” use a volume model, i.e. they try to produce a standard product in large quantities with restricted margins. Market differentiation is mainly done on price and less on product quality or product parameters. Both companies use three types of farms: own, integrated and independent. Control of production quality is difficult due to different ways of data capture and analysis; the companies have to employ own personnel to guarantee equal accounting of factors. An electronic exchange of data would help to streamline this process.
- The openness that the companies and attendants of the workshop displayed when interviewed was very pleased and seems to give trust in the image of PLF.
- In the questionnaire **Animal health** is the most important factor, followed by **food safety, environment and animal welfare**. More than two third of the respondents choose for the

answers related to these topics ‘**a guarantee for the future**’ or ‘**important for the preservation of the sector**’. Society and market orientated thinking scored some lower and control of energy use seems the less important factor.

- When entering the stable/barn farmers have most attention for Climate/air quality, disease symptoms and feed availability, followed by animal condition and water availability.
- Feed intake and disease monitoring are the most important inspection tasks which respondents want to have been automated.

Key indicators based on questionnaire:

The five most important **social key indicators** of PLF are:

- 1) Labour conditions (physical, dust, environment, light...)
- 2) Number of labour hours
- 3) Pride/motivation to talk about and show animal and production facilities
- 4) Availability of advisory systems
- 5) Successor for farm business to continue the farm

But also job satisfaction, participation in a study group for farmers, risk awareness, attractiveness of the farm to external investors and social recognition for a job well done are important.

The five most important **economic key indicators** of PLF are:

- 1) Feed conversion
- 2) Growth
- 3) Health costs
- 4) Delivery weight
- 5) Energy costs

But also uniformity, mortality, farm income, noble parts/units and control of waste production and manure are important.

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Appendix: PLF questionnaire for farmers and other stakeholders in the animal food chain

Goal: To get insight in the social and economic indicators that are relevant for the creation of added value for Precision Livestock Farming (PLF).

Focus: social and economic aspects of PLF

In this questionnaire, as part of a European project called EU-PLF (<http://www.eu-plf.eu/>), we would like to know how familiar you are with Precision Livestock Farming (PLF). We also want to identify factors that you believe would motivate farmers to apply this technology. (You can also call PLF 'SmartFarming' or 'Electronic Management System').

Information about the project

Introduction and background:

Precision Livestock Farming (PLF) develops management tools aimed at continuous automatic monitoring of animal production, which includes real-time monitoring of growth, health and welfare. Sensor technology integrated in monitoring systems allows farmers to follow the animal's status and observe their performance, detect diseases and other welfare problems at an early stage. In addition with the help of this technology, farmers and veterinarians can continuously and automatically collect and manage the information needed to assure citizens that livestock production is safe, welfare friendly and environmentally sustainable. It intends to support farmers and service providers in their daily management with extra eyes, ears, noses and hands, and making them more independent from the availability of human labour. Technology helps to detect needs of individual animals, sometimes even better and earlier than the human observation.

Benefits of PLF

A cornerstone in successful management of large herds is to combine information on individual animals with feed composition and rations, environmental conditions and management routines in order to achieve optimal productivity, welfare and health and simultaneously avoid over-feeding and feed wastage. A substantial amount of data is collected which has to be converted into useful information and decision support systems for farmers and service providers. To support this with PLF technology requires the development of mathematical decision support modelling, (wireless) sensor technology, ICT-infrastructure (web based, databases), standardisation (e.g. RFID) and user-centric design methods to evaluate the interest of cumulating data from different origins (biological, behavioural...) and the improvement of the quality of the diagnosis and support. PLF technology will assist the farmer with daily management choices, in areas with social, economic and technological issues.

Impact

New technological developments as described above will make the management activities of farmers and service providers more efficient and objective, and facilitate farming practices that reduce waste and emissions, detect early irregularities and improve welfare and health. However, the biggest impact is that farmers will be supported in providing care to individual animals that are part of groups, and taking care of the circumstances in which these groups have to function. PLF is a system innovation, affecting socioeconomic variables. **Further development of precision livestock farming will make Europe’s agricultural sector a global frontrunner.**

See also the website <http://www.eu-plf.eu/>

Privacy

You can fill in this questionnaire anonymous, but when you fill in your name and e-mail address at the end, we will handle your data confidentially.

Questionnaire

A/ IDENTIFICATION

1. Who are you or what company are you working for? (Please fill in the block which is most relevant for you and answer the other question from that perspective)

<input type="radio"/> Farmer In which animal section you are working? <input type="radio"/> Dairy <input type="radio"/> Pig <input type="radio"/> Poultry <input type="radio"/> Veal calves <input type="radio"/>	<input type="radio"/> Feed supplier <input type="radio"/> Dairy <input type="radio"/> Pig <input type="radio"/> Poultry <input type="radio"/> Veal calves <input type="radio"/>	<input type="radio"/> Developer of automation systems <input type="radio"/> Dairy <input type="radio"/> Pig <input type="radio"/> Poultry <input type="radio"/> Veal calves <input type="radio"/>
<input type="radio"/> Veterinarian <input type="radio"/> Dairy <input type="radio"/> Pig <input type="radio"/> Poultry <input type="radio"/> Veal calves <input type="radio"/>	<input type="radio"/> Food company (slaughterhouse-milk company) <input type="radio"/> Dairy <input type="radio"/> Pig <input type="radio"/> Poultry <input type="radio"/> Veal calves	<input type="radio"/> Other: <input type="radio"/> Dairy <input type="radio"/> Pig <input type="radio"/> Poultry <input type="radio"/> Veal calves <input type="radio"/>

1a When you are a farmer, how many animals do you have on your farm?

2. Which country are you working in: _____

3. How important is animal welfare for your farm (or the farms you are in relation to)?

- 1 Animal welfare is very important for the government but for me personally it is not
- 2 Animal welfare is important as long as it gives added value
- 3 Good welfare for me is a guarantee for the future
- 4 Animal welfare is important for the preservation of the sector in my country
- 5 Other (please specify)

4. How important is animal health for your farm (or the farms you are in relation to)?

- 1 Animal health is very important for the government but for me personally it is not
- 2 Animal health is important as long as it gives added value
- 3 Good animal health for me is a guarantee for the future
- 4 Animal health is important for the preservation of the sector in my country
- 5 Other (please specify

5. How important is the control of energy use for your farm (or the farms you are in relation to)?

- 1 Control of energy use is very important for the government but for me personally it is not
- 2 Control of energy use is important as long as the savings are substantial
- 3 Good energy control for me is a guarantee for the future
- 4 Energy control is important for the preservation of the sector in my country
- 5 Other (please specify

6. How important is the environment for your farm (or the farms you are in relation to)? (e.g. greenhouse gas emission, air quality, manure disposal)

- 1 The environment is very important for the government but for me personally it is not
- 2 Controlling the use of the environment is important as long as it gives added value
- 3 Controlled use of environmental resources for me is a guarantee for the future
- 4 Controlled use of environmental resources is important for the preservation of the sector in my country
- 5 Other (please specify.....)

7. How important is food safety for your farm (or the farms you are in relation to)? (e.g. traceability, certification)

- 1 Food safety is very important for the government but for me personally it is not
- 2 Food safety is important as long as it gives added value
- 3 Food safety for me is a guarantee for the future
- 4 Food safety is important for the preservation of the sector in my country
- 5 Other (please specify.....)

8. How important is market oriented thinking/acting for your farm (or the farms you are in relation to)?

- 1 Market orientation is very important for the government but for me personally it is not
- 2 Market orientation is important as long as it gives added value
- 3 Market orientation for me is a guarantee for the future
- 4 Market orientation is important for the preservation of the sector in my country
- 5 Other (please specify.....)

9. How important is society oriented thinking/acting for your farm (or the farms you are in relation to)?

- 1 Society orientation is very important for the government but for me personally it is not
- 2 Society orientation is important as long as it gives added value
- 3 Society orientation for me is a guarantee for the future
- 4 Society orientation is important for the preservation of the sector in my country
- 5 Other (please specify.....)

C/ Setting the scene for PLF:

10. Which of the following commercial PLF products/services do you know?

	Know	Use	Interested in
<ul style="list-style-type: none"> <input type="radio"/> eYeScan (Fancom) <input type="radio"/> eYeNamic (Fancom) <input type="radio"/> Dairy Management (Nedap) <input type="radio"/> Lactivator <input type="radio"/> BioSelect (Fancom) <input type="radio"/> EggCounting (Fancom) <input type="radio"/> SensOor (Agis automatisering) <input type="radio"/> Eye-blink™ (Petersime) <input type="radio"/> Bio-Iris™ (Petersime) <input type="radio"/> OvoScan™ (Petersime) <input type="radio"/> Synchro-Hatch™ (Petersime) <input type="radio"/> HerdNavigator (DeLaval) <input type="radio"/> Pigsort <input type="radio"/> Dynamic Feeding Dairy Cows <input type="radio"/> Enviro-detect <input type="radio"/> Feed-detect <input type="radio"/> Weight-detect <input type="radio"/> Pig Cough Monitor (Sound Talks) 			

11. Do you know/use other examples of PLF?

- No
- Yes

	Know	Use
<input type="radio"/>		
<input type="radio"/>		

12. Why would you implement PLF in your farm ? (Major reason):

.....

13. For which **social** aspects PLF can have a **beneficial** (+, ++, +++) or **detrimental** (-, --, ---) impact? [0 = indifferent]

- Number of labour hours
- Labour conditions (physical, dust/environment, light,)
- Working with a number of people on a farm
- Job satisfaction

- Social recognition for a job well done
- Pride/Motivation to talk and show animal and production facilities
- Cultural situation (differences between countries)
- Need to be physically present during production process
- Age, education, years of experience of the livestock keeper
- Risk awareness
- Participation in a study group for farmers
- Successor for farm business to continue the farm
- Availability of advisory systems
- Attractiveness of the farm to external investors
- "Others: please specify"

14. For which **economic** aspects (also aspects that have influence on economy) PLF can have **beneficial** (+, ++, +++) or **detrimental** (-, --, ---) impact? [0 = indifferent]

- Feed conversion (kg feed/kg meat)
- Control of waste production and manure
- Growth (g/day)
- Noble parts/units (breast meat, first grade eggs, mastitis free, ...)
- Uniformity (less slaughter waste and lean productions)
- Mortality (%)
- Deliver weight
- Energy costs (€/animal or lactation)
- Price (€/kg or piece) (for example: first grade eggs)
- Feed price (€/100kg) (incl. medication)
- Health costs (€/animal or lactation)
- Labour costs (€/h) as result of other educated employees
- Investment costs (€)
- Depreciation (€)
- Farm income
-
-

15. Which 3 observations have the highest priority when you enter the stable/barn?

- 1 Dead animals
- 2 Feed availability
- 3 Water availability
- 4 Disease symptoms
- 5 Climate/air quality
- 6 Animal condition (too lean or too fat)
- 7 Dirt on animals
- 8 Lameness
- 9 Aggression
- 10 Noise
- 11 Manure (consistency, colour, odour)
- 12 Animal sounds
- 13 Behaviour of animals
- 14

16. Do you think that monitoring of animal signals (responses of animals which can be measured automatically) can have an added value on your farm?

- 1 I don't see the added value for my farm
- 2 The added value is rather limited because technology is often not reliable
- 3 I think that it can have added value as long as the financial benefit is proven
- 4 I am convinced that this is the way for the future
- 5 Other (please specify

17. Which monitoring systems in your farm would you like to have automated?

- 1 Water use
- 2 Feed intake
- 3 Disease monitoring
- 4 Condition of the animals
- 5 Welfare indicators, such as aggression, lack or excess of mobility, non-uniform distribution of animals in the barn, lameness, stress etc
- 6 Product quality (eggs, milk, meat etc)
- 7

18. Do you think that usage of PLF-technology in animal farming would harm or improve the image of the sector?

- 1 Too much technology in animal farming is bad for the image of the sector
- 2 Use of technology in animal farming has no influence on the sector's image
- 3 By using the technology in animal farming, we can give the animal a comfortable life and this will benefit the image
- 4 Without the technology the sector will not survive
- 5 Other answer

19. Are you willing to participate in the testing of these new technologies in your farm?

- 1 Yes
- 2 No, rather not

20. Do you think something is missing in this survey? (open field in survey)

Privacy

You can fill in this questionnaire anonymous, but when you fill in your name and e-mail address at the end, we will handle your data confidentially.

Do you want be informed about further activities of EU-PLF (if yes, please ask for contact details)

Name:

E-mail:

Thank you for your responses and time.

The results of this questionnaire will be published later on <http://www.eu-plf.eu/>



Smart Farming for Europe

*Value creation through **P**recision **L**ivestock **F**arming*

